Library Noise Detector and Short Information Provider

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A Design Report Submitted to the School of Electrical Engineering, Electronics and Communications Engineering, and Computer Engineering in Partial Fulfilment of the Requirements for the Degree

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Approval Sheet

Mapúa Institute of Technology
School of EE-ECE-CoE

This is to certify that we have supervised the preparation of and read the design report prepared by **Caryll S. Ferrer**, **Harvey S. Lim** and **Aubrey Rae P. Ronquillo** entitled **Library Noise Detector and Short Information Provider** and that the said report has been submitted for final examination by the Oral Examination Committee.

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ABSTRACT

The Library Noise Detector with Short Information Provider is a portable device that is used in detecting noise in the library. The device is used to control excessive noise inside the library. The system uses an operational amplifier as a sensor to detect noise and microcontroller in displaying the output in the message display. The design was developed as an alternative or additional help in controlling the noise and prevent disturbances in a specific area of the library.

Keywords: library, sensor, noise, noise detector, microcontroller, operational amplifier, message display

Chapter 1

DESIGN BACKGROUND AND INTRODUCTION

a. The design setting or context or frame of reference

Noise is widely known in science and technology. Its general meaning in such fields, as in everyday life, is useless or interfering signal of some form. It is any unwanted sound due to a variety of causes. Often, noise is a nuisance because it interferes with a measurement that it is being made or with some signal that is being transmitted. The amount of signal, divided by the amount of noise that is also present, is often called 'signal – to – noise ratio'. Techniques such as electronic filtering are often used to improve the signal – to – noise ratio. This is useful if the signal that is being looked for is at particular frequency; the filter allows that frequency to pass through, but not the other frequencies which are present in the noise. The study of noise is important, because by understanding the processes that cause it we can try to reduce it. Judgments of whether or not environmental sounds are noises are subjective, but the fact is that unwanted sounds can precipitate severe psychological effects. In addition, above certain levels of intensity, noises can cause physical harm.

Such uses of the term noise have been extended to the fields of electricity and electronics and, in general, to all areas that involve some form of frequency range. Noise is generated within electron tubes and electrical conductors in general, and all circuits posses an inherent level of random noise. External interferences also contribute to electrical and electronic noise.

Broadly speaking, the term noise is used in information theory to refer to any form of disturbance of information-bearing signals, or to any meaningless addition to such signals. This does not, however, include redundant signals added as means of checking the accuracy of the signals.

Noise levels are usually measured in decibel unit. A decibel is one tenth of a bel **(**B**).** Devised by engineers of the Bell Telephone Laboratory to quantify the reduction in audio level over a 1 mile (1.6 km) length of standard telephone cable, the bel was originally called the transmission unit or TU, but was renamed in 1923 or 1924 in honor of the laboratory's founder and telecommunications pioneer Alexander Graham Bell. In many situations, however, the bel proved inconveniently large, so the decibel has become more common.

The decibel **(**dB**)** is a logarithmic unit of measurement that expresses the magnitude of a physical quantity relative to a specified or implied reference level. Its logarithmic nature allows very large or very small ratios to be represented by a convenient number, in a similar manner to scientific notation. Being essentially a ratio, it is a dimensionless unit. Decibels are useful for a wide variety of measurements in acoustics, physics, electronics and other disciplines. The decibel is not an SI unit, although the International Committee for Weights and Measures (CIPM) has recommended its inclusion in the SI system. Following the SI convention, the *d* is lowercase, as it represents the SI prefix *deci-*, and the *B* is capitalized, as it is an abbreviation of a name-derived unit, the bel (see below). The full name decibel follows the usual English capitalization rules for a common

noun. The decibel symbol is often qualified with a suffix, which indicates which reference quantity has been assumed. For example, "dBm" indicates that the reference quantity is one milliwatt. Noise is always present everywhere but prohibited to areas that needs to have a peaceful environment such as libraries.

Library is a study place for people especially for students. It is a place where books, journals, compact discs, microforms, other media, and online access systems connect searchers to cultural, factual, educational, and recreational information. This information may be found in the local library or at other sites in an expanding global network of bibliographic databases. Public libraries provide access to materials of general interest and are open to everyone. School libraries support student research and enrich curriculum by integrating cultural and educational resources into classroom instruction. Corporate libraries provide businesses with access to current research and developments in their fields and sustain productivity and competitiveness. In the mid 1990's, there were approximately 76,500 school, 15,200 public, 6,000 corporate, 4,600 college and university, and 4,100 law, medical, and religious libraries in the United States, and Mexico. These range in size from the Library of Congress to the smallest elementary school library. In addition, there are libraries serving the media and professions. American libraries currently are expanding and enriching their services in an economy dominated by converging, computing, and communication technologies while facing severe cutbacks in public funding and government support.

A quiet ambiance is essential in the library; it should have a peaceful and noiseless environment all the time to avoid distractions to library users. But most of the time, as the people in the library increase; noise is always present and cannot be easily managed by the library staffs. With this implication, the groups decided to design a system that can help detect noise in the library with an alert message provider to let the people become aware whenever they are making loud noises. The device will monitor the library without further intervention of the library staffs.

b. Statement of the Problem

Generally, the library is a learning place for everyone. In places like this where people are always present the tendency of having noise cannot be avoided. When library becomes a noisy environment the main library rule to observe silence is violated. As the people in library increase, there is a bigger probability to have uncontrollable noise inside the library. In this case, the library staffs have a hard time controlling and informing the people that they are creating intolerable noise that can disturb others.

c. Objective of the Design

The design aims to create a device that will detect excessive noise inside the library as well as inform the library users of the rules and regulations that are strictly implemented.

The following points were considered in order to implement the design project:

1. To be able to lessen the library staff's task in maintaining a quiet ambience;
2. To interface noise detector circuit with a microcontroller-based message display; and
3. To design an effective and efficient device for the use of school libraries.

d. The Significance of the Design.

The design provides the library staff with a means of immediately controlling the noise level inside the library with any arrangement of the people. It further provides a means of instructing students to accept responsibility for maintaining a level of noise in to the library conducive to studying. The message provider presents a good alternative in posting or displaying the library rules and regulations.

For the designers being also student is and having the right to use the library, it is important for them to implement the design to help the library staff in managing and making the library a better learning place. All the people using the library will benefit from the design especially when they are annoyed of the noise and distractions created by unconcerned people.

e. Conceptual Framework

In order to build the design, Ideas and principles related to the design were studied and discussed. Figure 1.1 shows the conceptualized design of the system. This conceptual framework illustrates how the system of the design works starting from its inputs then how it will be processed until it produces an output.

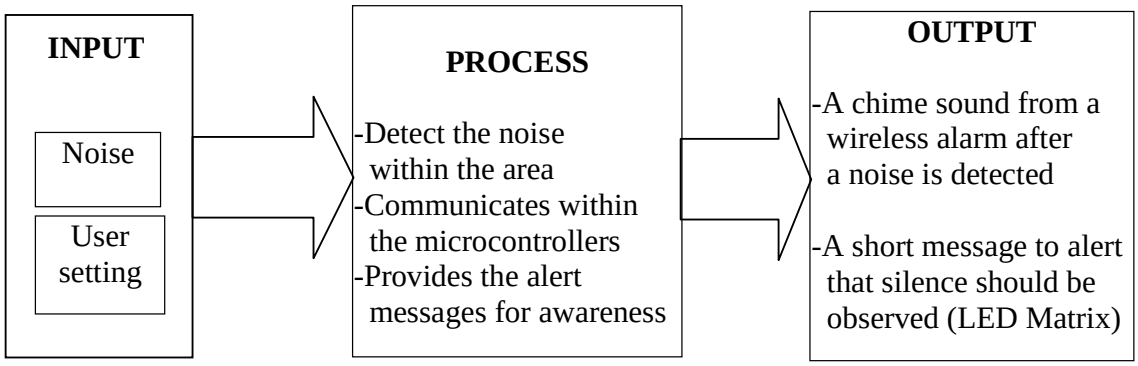
INPUT
Noise
User setting
PROCESS
-Detect the noise within the area
-Communicates within the microcontrollers
-Provides the alert messages for awareness
OUTPUT
-A chime sound from a wireless alarm after a noise is detected
-A short message to alert that silence should be observed (LED Matrix)

Figure 1.1 Conceptual Frame work

The inputs are the noise and the user settings which are independent variables that come from the user and the surroundings. The noise is the main input for the design that needs to be detected. The noise level that the detector should identify can be varied through a potentiometer. After the noise is detected, the two microcontrollers will act as the communication medium for the detector and the output devices. The Z86733 microcontroller will process the signal that the detector sends and then pass the alert message made or chosen by the user to the PIC16F877 microcontroller for it to output in the 8x8 LED Matrix. A chime sound will first occur after the detected noise is processed and

then followed by a short alert message. This concept describes how the device was designed for its environment and its users.

f. Scope and Delimitation

The device covers and delimits the following:

Scope

1. The noise level that the detector should detect can be varied through a potentiometer.
2. LCD display is used to see the saved messages or user input message. The keypad can be used to input lowercase and uppercase letters and numbers as well or a combination of different format of characters.
3. The LED matrix is used for message display.
4. Select button and delete button are provided.
5. A chime sound will occur once a noise is detected and the selected message will appear.
6. It automatically returns to a monitoring mode with a default message upon completion of its response mode.
7. The device is a stand alone; it does not need a computer or other devices to change message and do other things.
8. It will use the principle of noise detector.

Delimitation

1. The detection of noise may be delayed considering the distance and the volume of noise from the microphone.
2. The message length can reach up to 35 characters only.
3. The standby mode has a default message that cannot be changed by the user.
4. There are only limited numbers of messages to choose from the design project.
5. The different messages to choose from are installed in the microcontroller which is limited to four different rules and regulations of a library.
6. User input message should be placed before the noise detector detects a noise.
7. The scrolling messages experience delay because it also considers the blank spaces as a character.

g. Definition of Terms

These are the technical terms which are mentioned in the design documentation and design as follows:

1. **Alarm –** a device that signals the occurrence of some undesirable event (Electronics for the Electrician).

2. **Analog –** implies a continuous signal in contrast with digital, which breaks everything into numbers (Instruments and Measurements for Electronics).
3. **Assembly** - translation of computer language; the translation of assembly language into machine language (IBM PC Assembly Language).
4. **Breadboard** – a thin plastic board used to held electronic components that are wired together (Electronic Devices).
5. **Decibel –** literally means one tenth of a bel. A unit named after Alexander Graham Bell. It is not an absolute unit but rather it is indicated the relation between two powers (Communications Engineering, Black Book).
6. **Detector –** a device that recovers information of interest contained in a modulated wave (Electronic Sensors for the Evil Genius).
7. **Device** – an invention serving a particular purpose, especially a machine used to perform one or more relatively simple tasks (Instruments and Measurement for Electronics).
8. **Electret Microphone –** a type of condenser microphone which eliminates the need for a power by using permanently-charged material (Electronic Sensors for the Evil Genius).

9. **Frequency –** the number of complete cycles per second in alternating current direction. The standard unit of frequency is the hertz (Hz) (Electronic Devices).
10. **IC –** or "Integrated Circuit"; a tiny complex of electronic components contained on a thin chip or wafer of semiconducting material (Digital Design).
11. **Keypad -** a set of buttons arranged in a block which usually bear digits and other symbols but not a complete set of alphabetical letters (Electronics for Electrician).
12. **LED** - light-emitting diode; a semiconductor diode that emits light when conducting current and is used in electronic equipment, esp. for displaying readings on digital watches, calculators, etc. (Electronic Devices).
13. **Library -** a collection of books, newspapers, records, tapes, or other materials that are valuable for research (The World Book Dictionary).
14. **Microcontroller** - a single chip that contains the processor, non-volatile memory for the program, volatile memory for input and output, a clock and an I/O control unit (Electronics for Electrician).
15. **Noise –** an unwanted energy, usually of random character, present in transmission system, due to a variety of causes (Communications Engineering, Black Book).

16. **Noise Level –** are measured with noise level meters, generally with a weighting that mirrors human sensitivity to different frequencies (Communications Engineering, Black Book).
17. **Operational Amplifier –** special type of amplifier exhibiting very high gain, very high input impedance, very low output impedance, and good rejection of common diode signals (Electronic Devices).
18. **PCB** – used as dielectric fluids in transformers and capacitors, lubricants, and stabilizing additives in flexible PVC coatings of electrical wiring and electronic components (Electronic Devices).
19. **PIC –** or "Programmable Interface Controller"; a type of microcontroller that is widely used due to their low cost, serial programming and re-programming with flash memory capability (Electronics for Electrician).
20. **Potentiometer** – an electronic component that is used to vary the amount of current flows through a circuit. (Electronic Devices).
21. **Prototype -** building an actual circuit to a theoretical design to verify that it works, and to provide a physical platform for debugging it if it does not (Fundamentals of Electronics, vol.3).
22. **Sensor -** a device that measures or detects a real-world condition, such as motion, heat or light and converts the condition into an analog or digital representation (Electronics Sensors for the Evil Genius).
23. **Signal – to – noise ratio -** the amount of signal, divided by the amount of noise that is also present (Electronic Devices).

24. **Sound –** created when objects vibrate, resulting in a minute variation in surrounding atmospheric pressure (Communications Engineering, Black Book).
25. **Sound Level Meter -** measures sound pressure level and are commonly used in noise pollution studies for the quantification of almost any noise (Communications Engineering Black Book).
26. **Transducer –** electronic device that converts energy from one form to another (Electronic Devices).
27. **Zilog –** a onetime programmable microcontroller which helped to create the personal computer industry (Electronics for Electrician).

Chapter 2

REVIEW OF RELATED LITERATURE AND RELATED STUDIES

Noise detection: Bandwidth uncertainty and adjustable channels

Previous work has shown that the detection of band-pass noise patterns is well described by an ideal observer, indicating that observers can integrate spatial frequency information efficiently over a six-octave wide band (Kersten, 1987). One interpretation of this result is that observers use a channel with an adjustable bandwidth that matches the bandwidth of the signal when detecting band-pass noise (Green, 1960). To investigate the notion that observers use adjustable bandwidth channels for spatial frequency, we had observers perform a noise detection task under two conditions: an uncertainty condition where the bandwidth of the noise could vary from trial to trial and a blocked condition where the bandwidth of the signal was held constant during a block. We used horizontal, one-dimensional, band-pass noise patterns that were Gaussian windowed. The center-frequency of the noise was 5 cycles/degree and bandwidth varied from one-half to four octaves. Seven bandwidths were used and a detection threshold measured at each bandwidth for both the blocked and uncertainty conditions. Stimuli were presented for 200ms. At each bandwidth, three 150 trial thresholds were collected. Noise detection r.m.s. contrast thresholds increase with the fourth-root of bandwidth for the ideal observer. For our blocked condition, we again found that human observers' noise detection thresholds increase with the fourth-root of bandwidth (Kersten, 1987). Under

conditions of bandwidth uncertainty, we found that detection thresholds continued to increase with the fourth-root of bandwidth. Our results support the notion that when detecting wide-band noise patterns, observers can adjust the band of spatial frequencies they use from trial to trial and select the frequency band efficiently. To explore adjustable channels further, we are investigating the effects of stimulus duration, center-frequency uncertainty and the combination of center-frequency and bandwidth uncertainty on noise detection.

Room Noise Detector

Figure 2.1 Shows the circuit of an existing room noise detector Which is used as the basis of the circuit of the library noise detector. However instead of using fixed resistors, a variable potentiometer is used for the variation of noise levels.

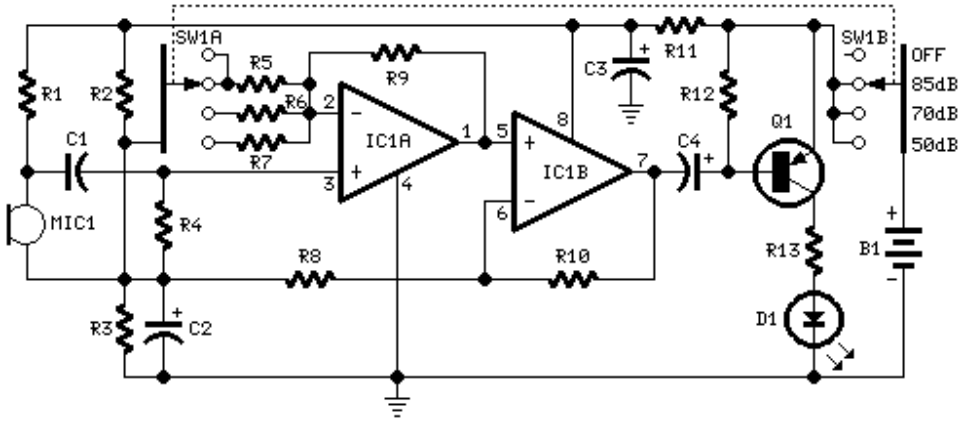

Figure 2.1 Circuit diagram of room noise detector.

The 50 db setting is provided to monitor the noise in the bedroom at night. If the LED is steady or flashes bright often, then the bedroom is inadequate and too noisy for sleep. The 70 dB setting is for living rooms. If this level is often exceeded during the day, the area is uncomfortable. If the noise

level is constantly over 85 dB, light 8 hours a day, then the environment is dangerous.

LM358 IC Dual Operational Amplifier is used to provide necessary circuit gain for sounds picked-up by a miniature electret microphone to drive a LED. Voltage gain should be measured in order to quantify if the sound entering the circuit is considered as noise in the circuit. The same IC is used to make the design of the project possible.

Snore Alarm Electronic Device

Figure 2.2 Snore Alarm Electronics Device

Figure 2.2 is the picture of the snore alarm electronic device. Breathe is a repetitive phenomenon. Moments of silence and noise repeat. Detection of snoring is based on the recognition of the cycle silence-snoring. The duration of each silence is compared to the duration of the previous silence.

1. The duration of each noise is compared to the duration of the previous noise. The precision of the periodicity of the cycle as well as the number of

successive cycles necessary to trigger the alarm can be configured by the use of jumpers connected to the input port of a micro controller.

Based on Figure 2.3 the snore alarm electronic device uses two potentiometers, one to control the sound level of the tweeter and second to control the final gain of the analog amplifier. When the user wants to increase the sensitivity, the knob should be turned clockwise and at the middle course, a long liner airplane at 10000 feet makes enough noise to switch off the LED. On power up, a timer is reset and starts to count. The device is active only for the first two hours and after six hours. If the alarm triggers after fourteen hours, it means that a new night started and the timer is reset. This is to avoid alarms right in the middle of the night.

This circuit is used to apply potentiometer in the design project.

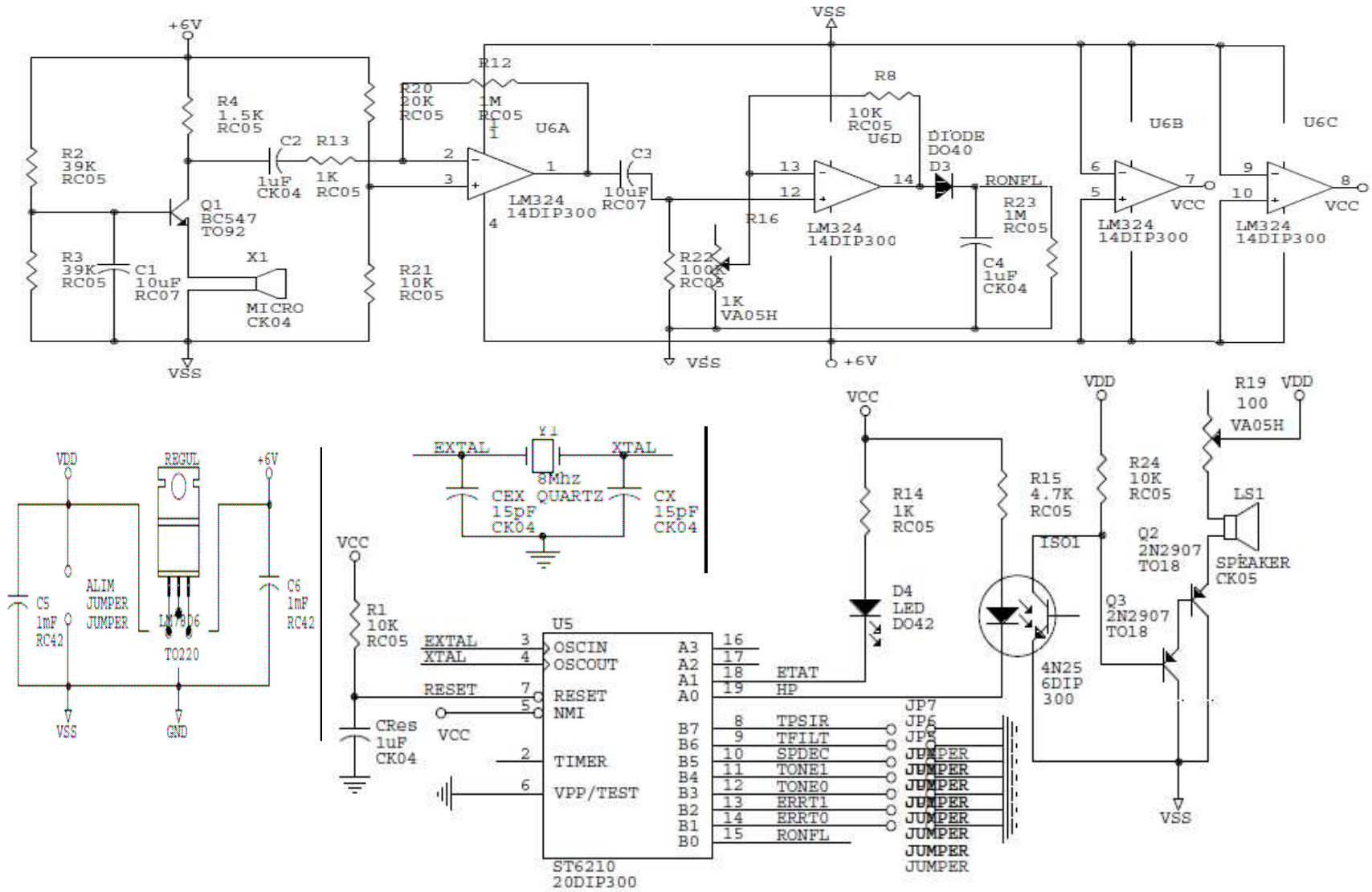

Figure 2.3 Schematic Diagram of Snore Alarm Electronic Device

Noise sensor simplifies automated noise monitoring

Based on this research study, the Cirrus Environmental has launched its MK:427 noise sensor - a self-contained outdoor noise meter that connects directly to SCADA systems. The sensor allows noise level data to be incorporated into Process Measurement and Control systems. The data can be stored to provide a complete record of a plant's noise activities, and can also be used to control noisy processes in real time. For example, a pump or fan can be throttled back when the noise it generates reaches an excessive level at the site boundary. Unlike a conventional sound level meter, the MK: 427 convert the noise level in decibels into standard 4-20mA and linear DC outputs. With the 4-20mA output, very long cable lengths can be used without reducing the accuracy of noise measurements. The sensor incorporates a 1.2m microphone pole, allowing the microphone to be positioned in free space, well away from any obstructions.

Cirrus said that the pure analogue electronics are reliable and operate without any user intervention. The sensor hardware is based on a well-established Cirrus design that has been proven in harsh weather conditions. To ensure that the sensitive microphone transducer is always in good condition, it is fitted with an electrostatic actuator calibrator. This can be used to make regular fixed-point calibrations of the entire measuring chain, thus verifying data integrity. A pre-scaling calibration system allows any 65dB span in the range 20 to 130dB to be selected by the user.

Cirrus Environmental aims to help organizations measure the noise they make and thereby help manage the impact that noise has on neighbors and the surrounding environment.

WHO Standard Environmental Noise

The World Health Organization has published guidelines suggesting the environmental noise lead:

Where?	Why?	dB
School playground (outdoors)	Avoid annoyance.	55
Hospital rooms	To avoid disturbing sleep.	30
Classrooms	To ensure that speakers can understand one another.	35
Libraries	To avoid destructions and annoyance to others.	40
Factories, traffic, shopping areas, both indoors and outdoors	To avoid hearing impairment.	70

Table 2.1 World Health Organization suggested environmental noise level.

The information outlined in Table 2.1 is used as a basis to the setting of the noise level that the noise detector should detect.

Decibel Loudness Chart

These are the measured increase in decibel level that depends on the change of the volume of sound.

PERCEPTIONS OF INCREASES IN DECIBEL LEVEL	
1 db	Imperceptible change
3 db	Barely perceptible change
5 db	Clearly noticeable change
10 db	About twice as loud
20 db	About four times as loud

Table 2.2 Perceptions of Increases in Decibel Level

Based on Table 2.2, the allowable additional amount of decibel level should only limit with the values given in the table to have an acceptable change of sound level in the sense of hearing.

These data are collected from a variety of sources which can help one to understand the volume levels of various sources and how they can affect our hearing.

ENVIRONMENTAL NOISE	
DECIBEL	EXAMPLE OF SOUND SOURCES
0 db	Weakest sound heard
35 db	Whisper Quiet library
60-70 db	Normal conversation
80 db	Telephone dial tone
85 db	City traffic (inside car)
90 db	Train whistle at 500', truck traffic
95 db	Subway train at 200'
90-95 db	LEVEL AT WHICH SUSTAINED EXPOSURE MAY RESULT IN HEARING LOSS
107 db	Power mower at 3'
100 db	Snowmobile, motorcycle
110 db	Power saw at 3'
115 db	Sandblasting, loud rock concert

Table 2.3 Environmental noise

Table 2.3 pertains to different environmental noises and their equivalent noise level measured in decibel.

The Occupational Safety and Health Administration (OSHA) suggested the following daily permissible noise level exposure.

OSHA DAILY PERMISSIBLE NOISE LEVEL EXPOSURE	
HOURS PER DAY	SOUND LEVEL
8	90 db
6	92 db
4	95 db
3	97 db
2	100 db
1.5	102 db
1	105 db
.5	110 db
.25 or less	115 db

Table 2.4 OSHA Daily Permissible Noise Level Exposure

Based on Table 2.3, each person can only be exposed to these certain values of noise level directly proportional to the number of hours per day in order to avoid hearing impairment.

In an orchestral music room, each musical instrument has its own sound level of music. The commonly used musical instruments are listed with their corresponding sound level in Table 2.5.

The table shows the measurements of sound levels quantify the music from becoming noise. The sound level may also depend on the kind of music played by the musicians using these instruments and the volume of the music created. An excess in the sound level creates noise.

SOUND LEVELS OF MUSIC	
DECIBEL	**SOUND SOURCES**
60 – 70 db	Normal piano practice
70 db	Fortissimo singer, 3’
75 – 85 db	Chamber music, small auditorium
84 – 103 db	Piano Fortissimo
82 – 92 db	Violin
85 – 111 db	Cello
95 – 112 db	Oboe
92 – 103 db	Flute
90 – 106 db	Piccolo
85 – 114 db	Clarinet
90 – 106 db	French horn
85 – 114 db	Trombone
106 db	Tympani and bass drum
94 db	Walkman on 5/10
120 – 137 db	Symphonic music peak
120 db	Amplifier rock, 4-6’
150 db	Rock music peak

Table 2.5 Sound Levels of Music

These statistics for the Decibel Chart were taken from a study by Marshall Chasin, M.Sc., Aud©, FAAA, Centre for Human Performance & Health, Ontario, Canada. There were some conflicting readings and, in many cases, authors did not specify at what distance the readings were taken or what the musician was actually playing. In general, when there are several readings, the higher one is chosen.

Chapter 3

DESIGN METHODOLOGY AND PROCEDURES

Design Methodology

The Library Noise Detector with a Short Message Provider was developed for implementation in school libraries to be used as an alternative or additional help in controlling noise and prevent disturbances in a specific area of the library. The design is a microcontroller - based prototype that can stand-alone without connecting to computer devices.

The design methodology was applied research that is often used to solve practical problems that relate to this kind of study. This form of research is necessary to improve this field of technology. The group research is based on different designs of previous studies in relation to the design project. Additional information and concepts needed were gathered from books, journals, articles, and internet for further understanding of the design concepts. With this information, the group was able to portray the process of the system. This approach helps the design to obtain a balance to the objectives and expectations from the actual results of the produced design prototype.

Design Procedures for Actual Design

The noise detector application was used as a reference for the design. The circuit was customized so that the level of sensitivity can be varied. The logic of the process in making the design was carefully analyzed. The step by step processes in making the design are as follows:

1. The problem was determined and the factors that should be considered in the design were identified. The objectives of the design were set and ideas on how the prototype should be designed were gathered. Adaptation to the environment where the design will be implemented was also considered for the quality of the design itself.
2. Researches on related literature for the design and how to conceptualize the other related designs were done. Deciding on the approach and the possible applications that can be coordinated altogether for the design were one of the tasks was to find the suitable microcontrollers that can be used and tested using analog input from a serial data. These researches helped how the design should be implemented.
3. The circuit diagram of the noise detector was developed with the application of operational amplifier and a potentiometer for the variation of the noise level and the analog output needed by the microcontroller. The designed circuit was tested in the breadboard and during testing - the blinking of the LED indicator dictates the characteristic of the noise detection. Z86733, a Zilog Microcontroller was used in the process of connecting the Keypad inputs, displaying it to the LCD and sending the data to the other microcontroller. Each pin of this microcontroller was manipulated

how it will function and be connected to other devices. It also stored the program of the process and how the alarm can be manipulated according to its assigned function in the design. The Z86733 Microcontroller is also the communication medium for the PIC16F77, the microcontroller which connected the noise detector and the 8x8 LED Matrix.

4. Program listing was the next process after designing the circuit diagrams. The program applied the assembly language. A serial input of data was used to test the program to the design itself. Each function in the program was separated according to the objectives of the alert message displayed and the operation of the other devices connected to the microcontroller. The LCD was the output device for all the inputs in the keypad. The behavior of each button in the keypad was also included in the program listing including each delays and functions on interchanging characters in the keypad, which is similar to the characteristic of a cellular phone keypad. Additional buttons were also included in the design for editing the alert message and for choosing the library rules and regulations that would be saved inside the microcontroller. The stand-by message was also included in the program while the device is in the steady state.

5. After being tested, the circuit was transferred into a PCB layout to avoid loose circuitry as compare to the breadboard. The program was also burned in the ICs of the microcontrollers for further testing of the whole design prototype. Testing and experiments have been made to test if the program works according to its environment on a near and far range of noise. The testing and interpretation of data will be further discussed in the next chapter.

Hardware Design

The following diagram refers to the hardware design of the system:

1. Block Diagram

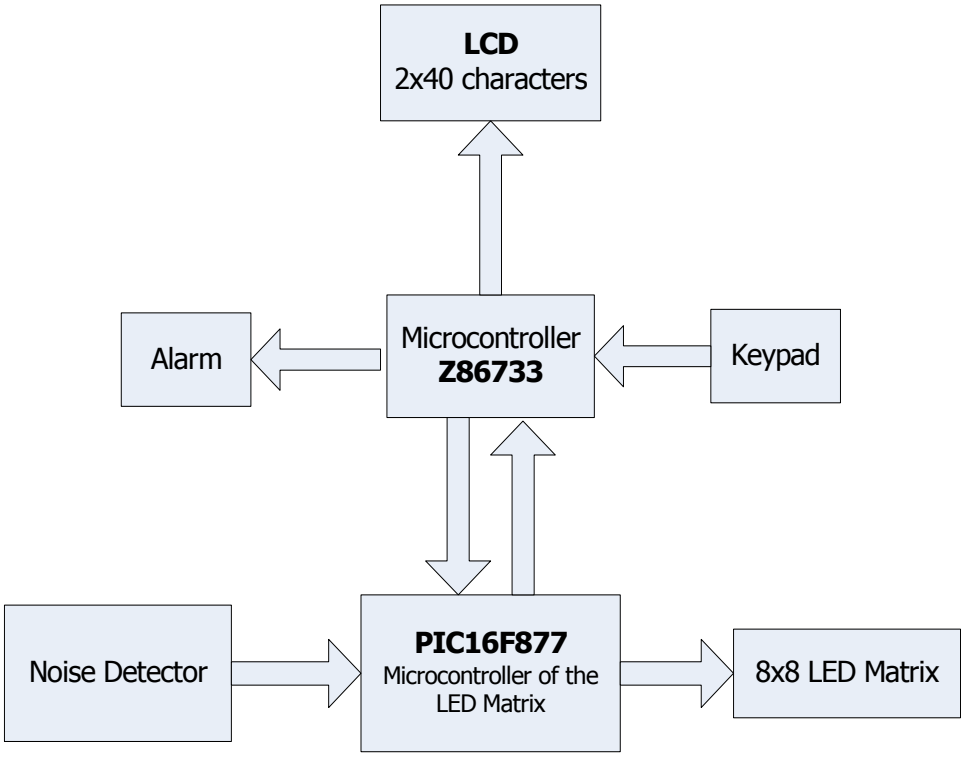

Figure 3.1 System Design Block Diagram

Figure 3.1 shows an illustration of the System Block Diagram for the system design. Initially, the user will set the desired noise level in the noise detector and an alert message to be displayed after detection. By using the keypad, the user can input alert messages which are temporarily shown in the LCD display. When the noise signal is detected and exceeds the noise level set, the PIC16F877 microcontroller is triggered. After the PIC microcontroller receives the signal, it will transfer to the Z86733 microcontroller and the alarm will be turned on. The Z86733 will acknowledge the transferred signal and it will then pass the user input message to PIC16F877 that controls the 8x8 LED Matrix for message display.

2. Schematic Diagram

The schematic diagram of the design system illustrates how the circuitry of the design was developed and connected with each other.

Figure 3.2 shows the whole circuit of the Library Noise Detector with Short Information Provider. This schematic diagram describes the different components used for the whole design system. This circuit operates as noise sensor and message provider that are put together as one design system. The block diagram represents the other circuit connected to the Z86733 microcontroller. For the schematic diagram of the power supply, refer to Figure 3.6.

Figure 3.3 refers to the schematic diagram of the Z86733 microcontroller. This microcontroller is responsible for handling the data to be displayed in the

LCD display and LED matrix. The seven pins of the keypad for the row and column are connected to the input ports of the Z86733. The input/output ports of the LCD display are connected to the Z86733 for displaying the data. The alarm switch is also connected to P01 of the microcontroller.

Figure 3.4 is the schematic diagram of the 8 x 8 LED Matrix display. The LED Matrix display is connected to PIC16F877 as driver to display the message. The PIC is connected to the noise detector and the Z86733 microcontroller. Once the noise is detected, it will trigger the PIC to display the message.

Figure 3.5 refers to the circuit of the noise detector. The noise detector uses LM358 IC which is a dual operation amplifier. The electret microphone is connected to the input part of the circuit. The circuit has a connection to the input of the PIC16F877 and connected to Z876733 to trigger the alarm and the message display once noise is detected.

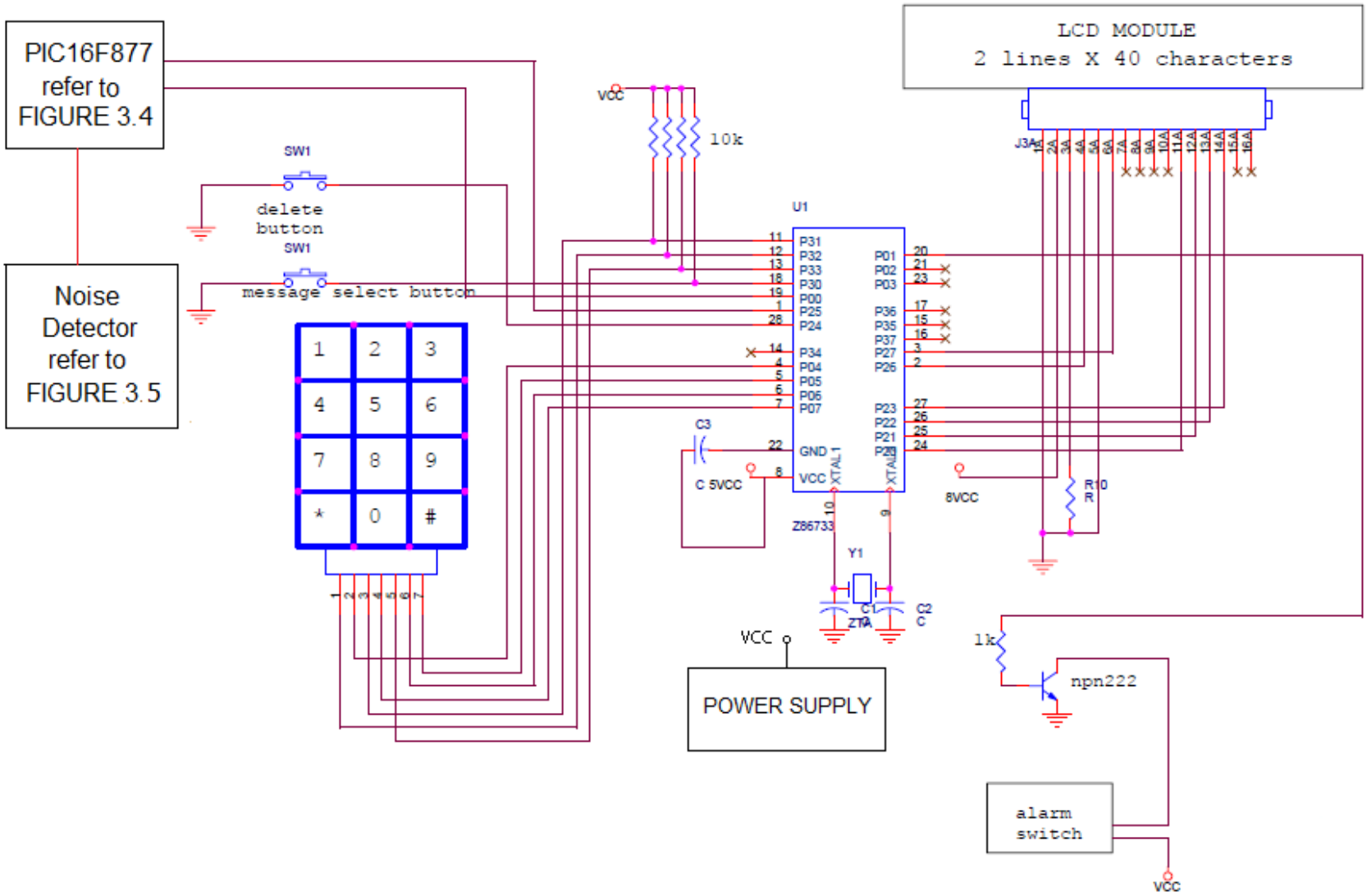

Figure 3.2 Schematic Diagram of the whole Library Noise Detector with Short Information Provider

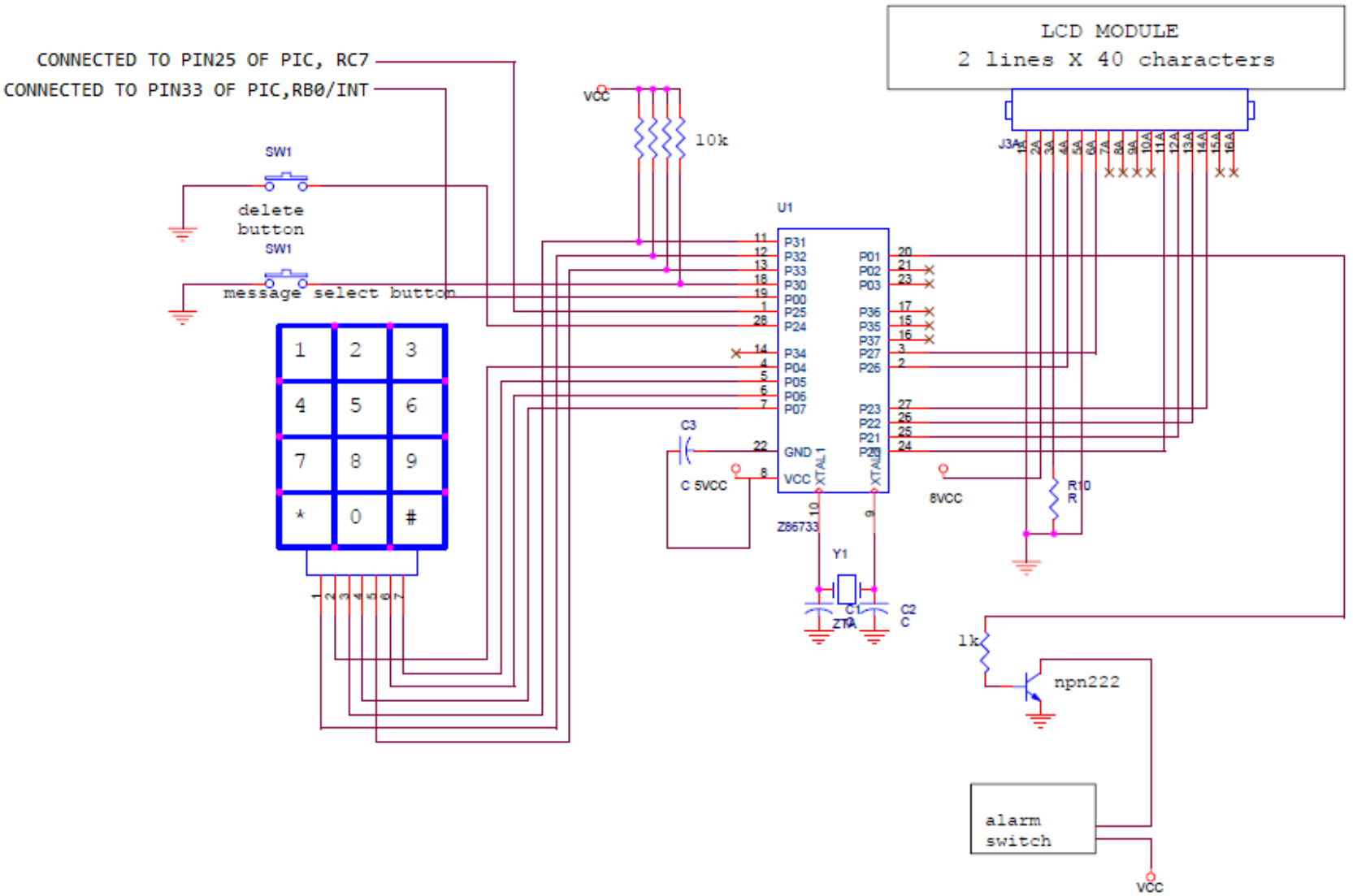

Figure 3.3 Schematic Diagram with Microcontroller Z86733

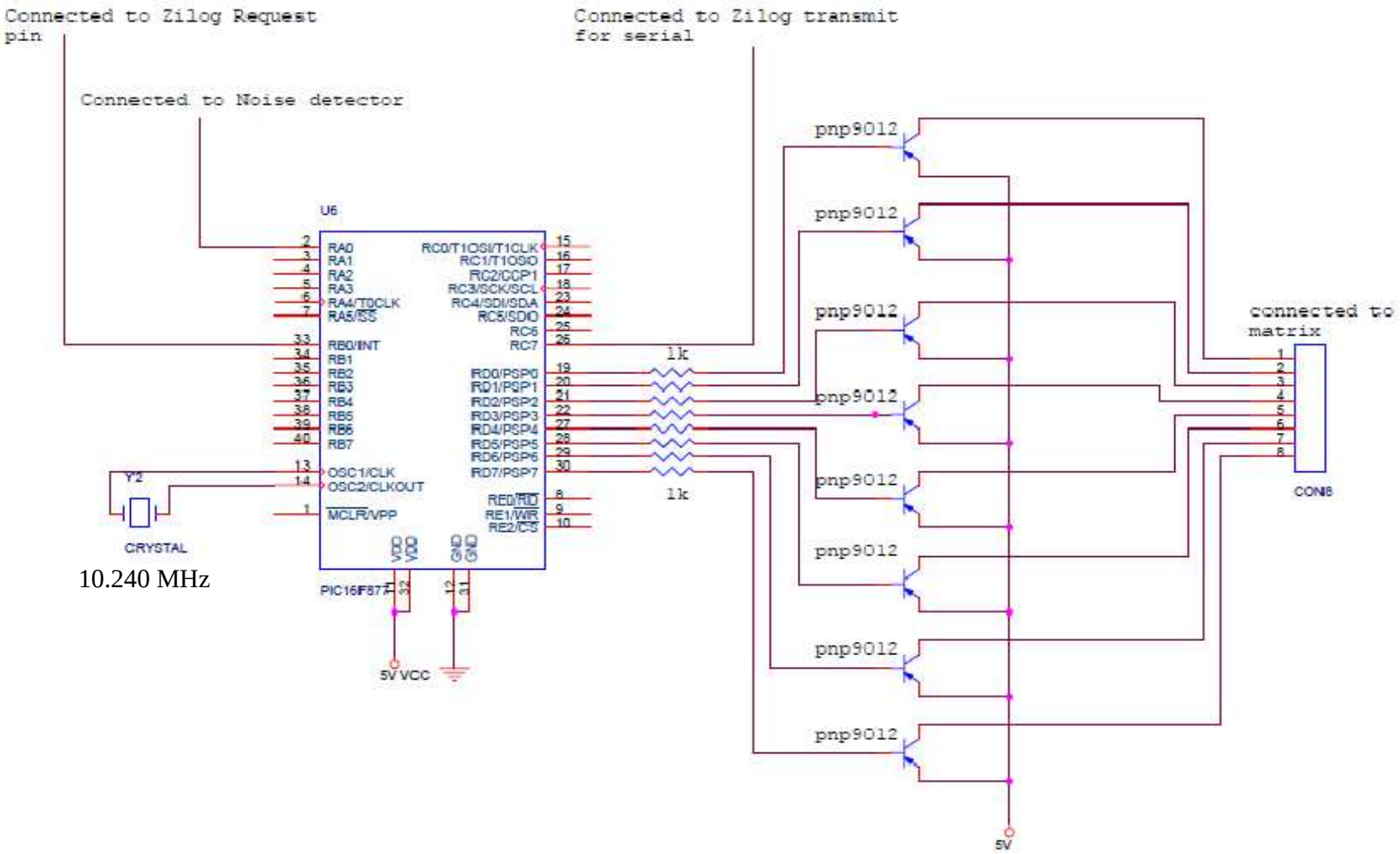

Figure 3.4 Schematic Diagram of Microcontroller PIC16F877 for the 8x8 LED Matrix

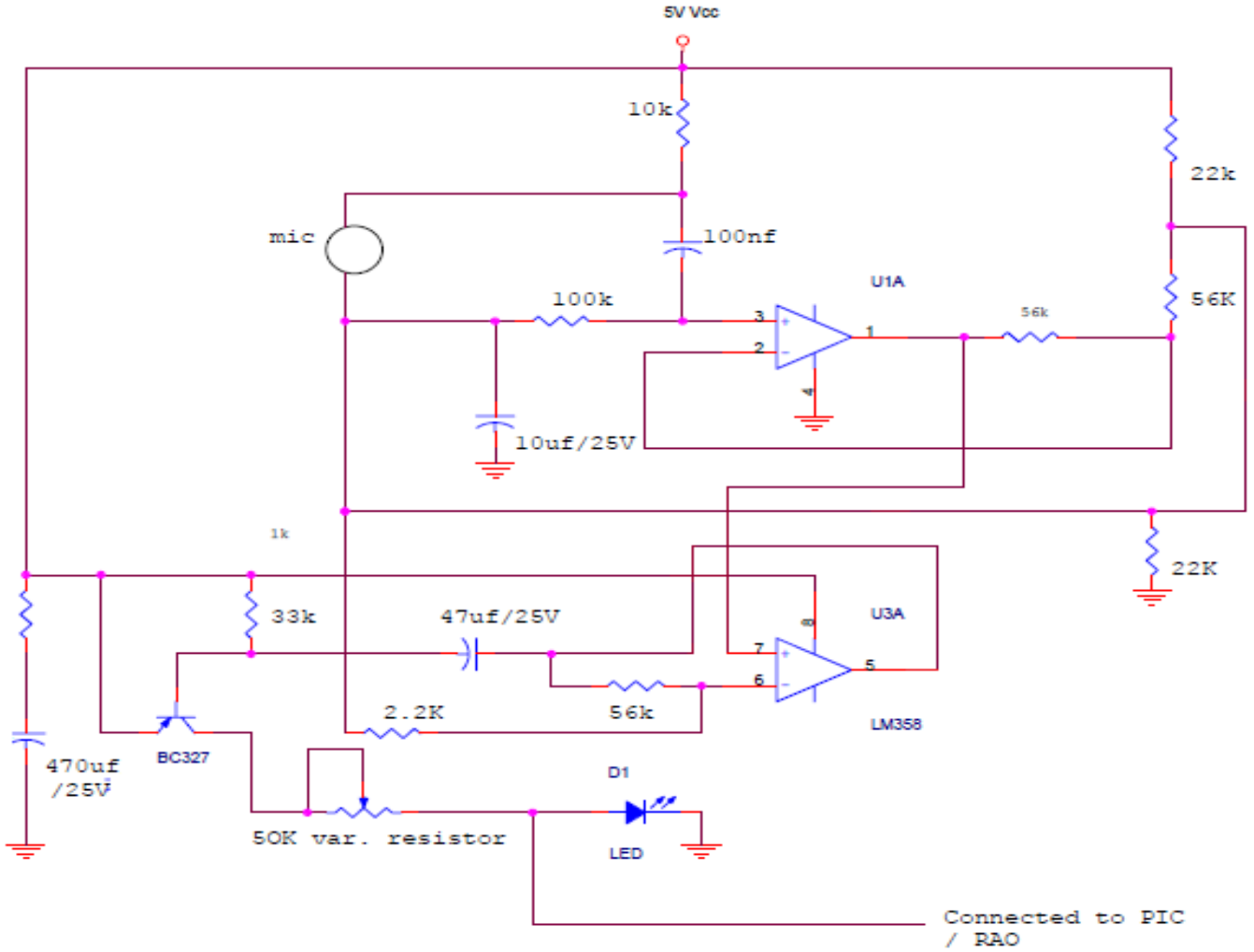

Figure 3.5 Schematic Diagram of the Noise Detector

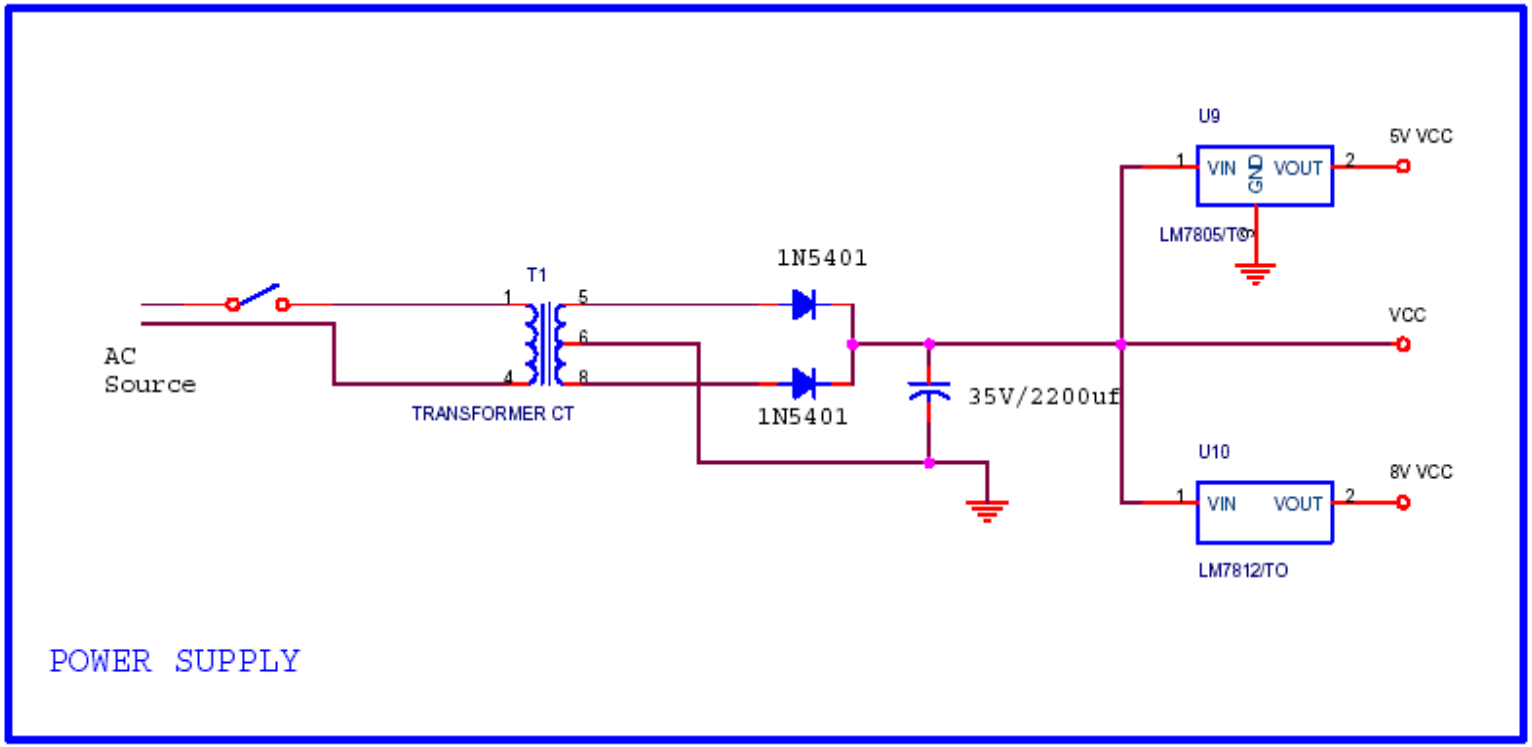

Figure 3.6 Schematic Diagram for the Power Supply

3. List of Materials

The following is the list of materials used in creating the circuit of the design system:

Materials	Quantity	Materials	Quantity
Z86733 Microcontroller IC	1 pc	03SBA10 bridge rectifier diode	1 pc
10.240Mhz crystal	1 pc	2200 uf/35v capacitor	1 pc
27 pf np capacitor	2 pcs	0.1 uf capacitor	4 pcs
78L05	1 pc	2n3904	8 pcs
Male-female connector	1 pc	Toggle switch	2 pcs
0.1 uf capacitor	1 pc	Tact switch	1 pc
Keypad	1 pc	14”x18” Plywood	2 pcs
2x40 LCD	1 pc	PCB	1 pc
1k resistor	3 pc	8x8 LED Matrix	2 set
10k resistor	6 pcs	Wireless doorbell	1 pc
56k resistor	3 pcs	Electret Microphone	1 pc
33k resistor	1 pc	1N4001	2 pcs
22k resistor	2 pcs	PIC16f877	1 pc
Lm7805/Lm7808	2 pc	LM358 Dual Operational Amplifier	1 pc
750 mA transformer	1 pc	2200 uf/25v	1 pc

Table 3.1. List of Materials

Hardware Components

These figures show the actual PCB layouts of the hardware components in the circuit.

PCB Layouts

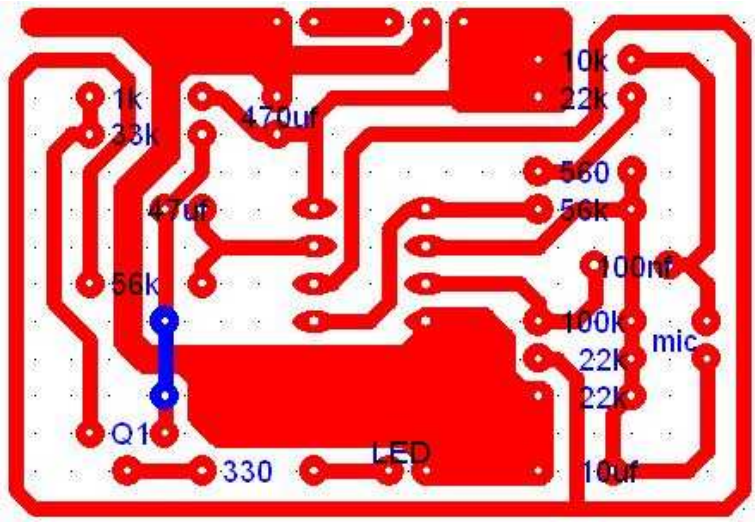

Figure 3.7 Noise Detector

Figure 3.7 shows the PCB layout of the circuit of noise detector. It is a double sided etched with single wired PCB design.

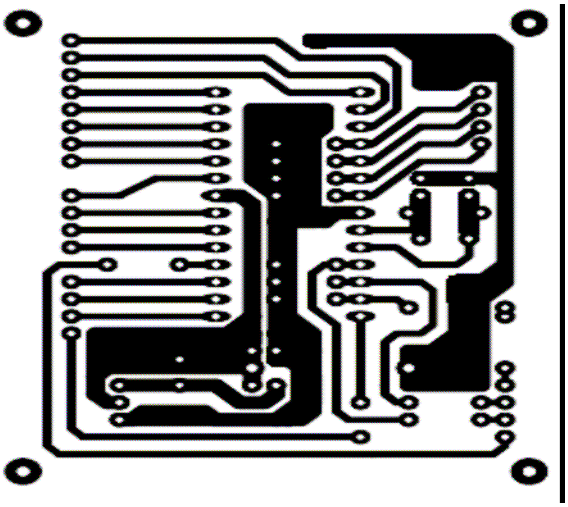

Figure 3.8 Z86733 Microcontroller

Figure 3.8 shows the PCB layout for the Z86733 Microcontroller. The layout shows how the other components such as resistors, transistors, and capacitors should be connected to the pin configuration of the IC.

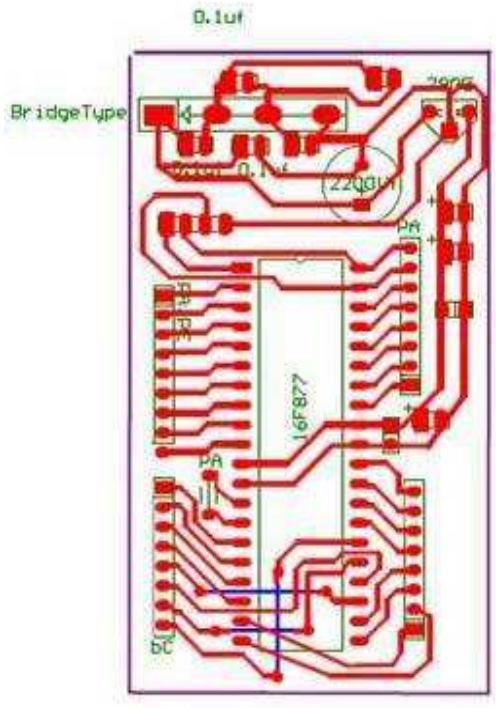

Figure 3.9 PIC16F877 Microcontroller

Figure 3.9 illustrates the actual PCB layout of the PIC16F877. This lay-out shows the connection on the IC of the PIC microcontroller of the crystal, capacitor, and voltage regulators as part of the hardware components.

LCD Display

The saved and input messages are displayed in the LCD. The data to be displayed will come from the microcontroller. The LCD will display the options of the user and the selected alert messages will be displayed in the LED Matrix.

Keypad

A keypad that operates like a cellular phone keypad was used for the user input message.

8 x 8 LED Matrix

Since the design displayed short information, an 8x8 LED Matrix was used to display information visible to the people inside the library. It is displayed the selected message of the user once noise was detected. It also displayed the default message while in standby mode.

Electret Microphone

The electret microphone serves as a transducer in the circuit. It converts noise to electrical signal given that the circuit is an electrical circuit. Basically, it is a cardiod type of microphone which is said to be the most common unidirectional since all microphones can only absorb when the source is in front.

Operational Amplifier

The operational amplifier has been found to be the best device for the system design. It is a device that amplifies the signal coming from the microphone. By getting the voltage gain in this stage, the noise can be quantified in the circuit. Its unique characteristic helped to make the design possible.

Software Design

The microcontroller was used for the design project. It gives control to the operation of the whole system of the design especially in interfacing the

noise detector with the LED Matrix display and also with the other input/output devices used in the circuit.

The microcontrollers save the data coming from the user for message display. It also functions as a medium for transmitting the noise signal coming from the noise detector. The main routine of the program of the microcontrollers is to save the user input data and to acknowledge the noise signal being detected.

Software Components

The software component part of the design is placed in the microcontroller which serves as the storage of the received data as well as the communication medium between the other parts and i/o devices within the system design. The language of the program in the Z86733 microcontroller is an Assembly Language which has simpler and shorter syntax of program codes. For the PIC16F877 microcontroller, the programming language used was C# for the LED Matrix display. The program codes are separated according to the different functions that will be performed by the i/o devices in the system design. Instruction sets used in the program dictates how each ports in the microcontrollers should be assigned and how each ports should function either as a receiver or sender of the data inputs and outputs as well.

1. System Flowchart

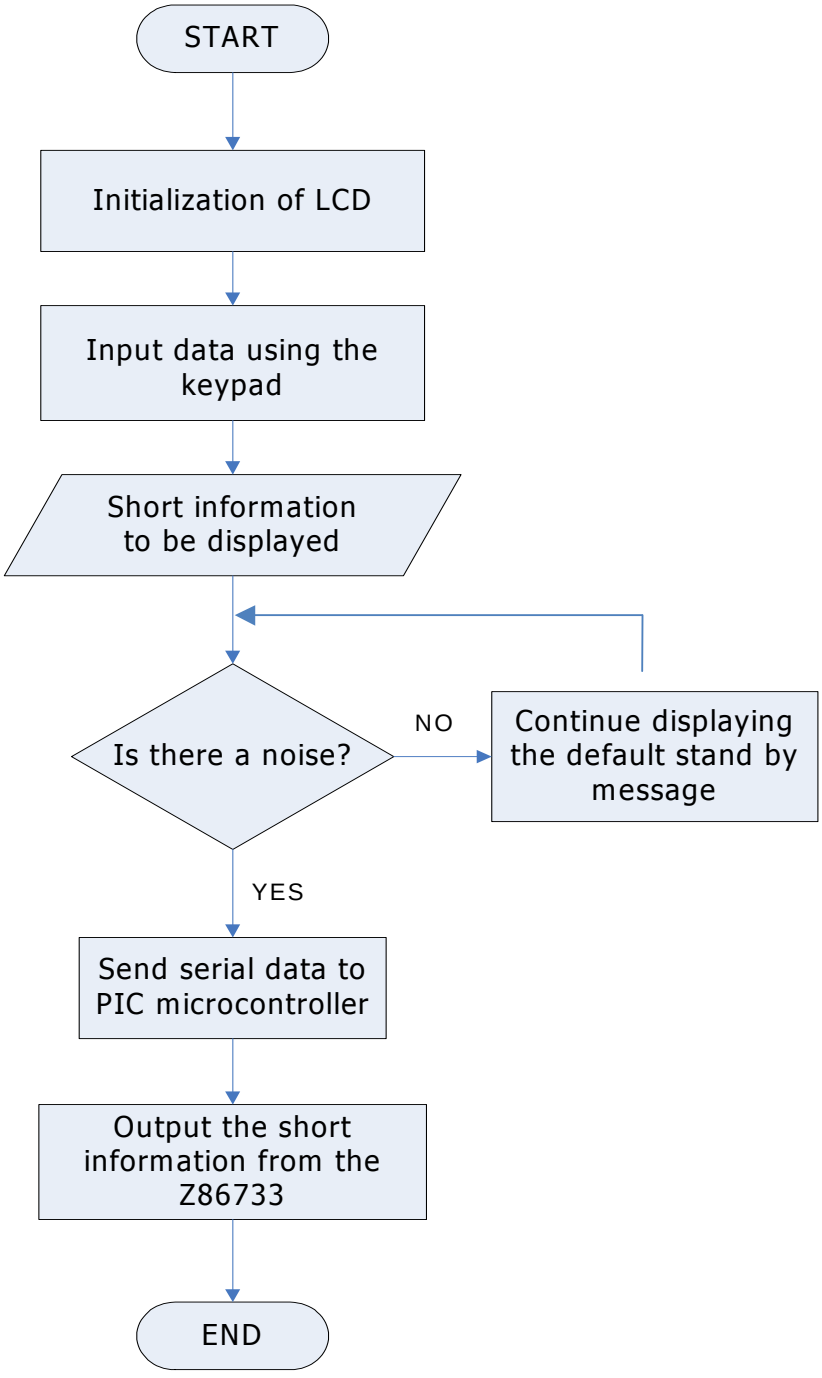

Figure 3.10 System Flowchart

Figure 3.10 shows the system flowchart of the design project. The flowchart specifies how the system decides and sets its condition before it outputs any results. It indicates the operation of the microcontrollers in processing the input data of the user and the input data coming from the noise detector. The flowchart is the overall route of all the inputs until it produces a certain output.

Prototype Development

The summary of the whole process of developing the Library Noise Detector with a Short Message Provider is as follows:

1. Submission and approval of the proposed design project
2. Conducting research on related studies, articles and literature about the system design.
    - 2.1 Existing circuit of noise sensors as basis.
    - 2.2 The applicable or suitable microcontroller to be used.
    - 2.3 The standard noise level for the environment of the library where the design should be implemented.
    - 2.4 The program language to be used for the i/o device.
3. Preparing the list of materials and electronic devices to be used for the design hardware.

4. Designing the circuitry of the noise detector with a variation of noise level.

5. Testing the circuitry and encoding the program listing for the message display

6. Modifying and testing the actual finish product of the design in an environment for demonstration purposes.

Chapter 4

TESTING, PRESENTATION, AND INTERPRETATION OF DATA

Since the design of the noise detector was based on an existing room noise detector as discussed in Chapter 2 of the Review of Related Literature and Related Studies, the circuit was redesigned by having a potentiometer instead of fixed values of resistances and several switches for setting the noise level to be detected. After the device has been constructed, several testing has been made on the prototype and the operation of each major components of the system. In testing the operation of the detection process, it is essential to know if the program responds with the electronic devices. Hence, checking was made by data validity and setting of the noise level of the noise detector.

Testing of the Operation of Noise Detector

In conducting the test, the circuit of the noise detector and the source of sound are needed. The initial testing made was checking if the existing room noise detector with a fixed noise level will work after replacing it with a potentiometer with variable resistances. The noise detector circuit was formed and temporarily tested in a bread board with a LED indicator for the noise detection. After the circuit was formed, it was placed in a slightly noisy environment. In this testing the exact noise level was not yet exactly measured.

KNOB POSITION OF THE POTENTIOMETER	STATUS OF THE LED	CONDITION
Approx. 50 dB	Lights on and continuously blinking	Very good
Approx. 65 dB	Lights on and blinking	Good
Approx. 85 dB	Lights on	Slight delay of detection

Table 4.1 Testing of the Operation of the Noise Detector

The result of this test showed the behavior of the noise detector as it detected noise or different sources of sounds from its environment. Since the noise level did not measure the threshold value of the resistance set for 50 db to 85 db, noise level the position of the knob showed how the noise level varied. The KNOB POSITION OF THE POTENTIOMETER became the comparative medium in determining the validity of the data in noise detection. Moreover, the STATUS OF THE LED can be determined when the LED lighted on as the noise detector detected noise. The CONDITION results indicated that the tests simply show that the noise detector is in good condition and that it can determine the validity of an input noise.

Quantifying the Noise in the Circuit

In order to quantify the considerable noise in the library based on the circuit of the noise detector, another test was made which showed how the noise level was set and how much voltage was needed to reach a certain noise level. To conduct the test, a digital multimeter and the noise detector circuit were used. The reference AC voltage as well as the variable resistances in the potentiometer was measured. The noise level depended on the voltage gain of the operational amplifier.

VOLTAGE	RESISTANCE	DECIBEL	CONDITION
9.49 V	50 Ω	50 db	Noise detected
30 V	12.5 K Ω	60 db	Noise detected
94.87 V	25 K Ω	70 db	Noise detected
533.48 V	51.4 K Ω	80 db	Noise detected

Table 4.2 How the noise is quantified in the circuit

Based on Table 4.2, the resistances in potentiometer are set and the output voltage is measured. The reference is a quiet environment in the library having a 0.03 AC voltage. The table shows the values of the output voltages that should be produced by the circuit in order to obtain the set noise level and trigger the message display. In order to compute the equivalent decibel value, the gain was computed based on the formula of db = 20 log (V_{out} / V_{in}). When the input noise reaches these certain amount of voltages, it is considered noise in the circuit. The standard noise levels can be found based on Chapter 2 on Review of Related Literature and Related Studies. The results of this test help the user to understand how the noise is quantified by the noise detector considering different kinds of sources from the environment.

Testing of Noise Detection with Different Source of Sound

To perform the test, the noise detector circuit and any sound source were needed. After learning how the noise level was set and varied from the results of its detection, another testing was done in a 7.4' x 6.3' x 8.1' room to show and test how the noise detector detects different sources of noise that are usually found in a library. In the test conducted, specific sound sources commonly heard in a school library were used. The Noise Detector was set to 50 db, 65 db, 85 db to detect noise based on the LED indicator and if the PIC16F877 was triggered to display an alert message. The status results are most likely expected to have similar results based on the earlier test done by the noise detector.

At 50 db noise level			
TEST	SOURCE OF SOUND	STATUS OF THE LED	REMARKS
1	Whistle	Blinking with high intensity of LED	Message displayed
2	Clapping	Continuous blinking of LED	Message displayed
3	Normal Conversation	Blinking with high intensity of LED	Message displayed
4	Blowing of horns (outside the room)	Blinking with Low intensity of LED	Message displayed
5	Music	Steady with High intensity of LED	Message displayed
6	Scream	Steady with High intensity of LED	Message displayed
At 65 db noise level			
TEST	SOURCE OF SOUND	STATUS OF THE LED	REMARKS
1	Whistle	Blinking with low intensity	No message displayed
2	Clapping	Continuous blinking with low intensity of LED	Message displayed
3	Normal Conversation	Blinking with low intensity of LED	Message displayed
4	Blowing of horns (outside the room)	No detection	No message displayed
5	Music	Steady with low intensity of light	No message displayed
6	Scream	Steady with low intensity of LED	No message displayed
At 85 db noise level			
TEST	SOURCE OF SOUND	STATUS OF THE LED	REMARKS
1	Whistle	Low detection, low intensity of LED	No message displayed
2	Clapping	No detection	No message displayed
3	Normal Conversation	No detection	No message displayed
4	Blowing of horns (outside the room)	No detection	No message displayed
5	Music	Steady light and dependent on the volume of sound.	Message displayed
6	Scream	Blinking with low intensity of LED	Message displayed

Table 4.3 Noise Detection with Different Sound Sources

Table 4.3 shows the different results in testing the library noise detector with different sources of sound. Based on the results, the noise detector can

easily detect constant noise and high pitch sounds. The detection varies with the kind of sound produced and its distance to the noise detector. The sensitivity of the sensor depends on the noise level set on the noise detector. If the noise level is low, the detector can easily detect noise and if the noise level is high, longer time is needed to detect noise. The intensity of light of the LED indicates how much noise is detected. When the intensity of light of the LED is high it means that the noise has reached the sound level set on the noise detector. If the LED blinks the noise is detected and it can either produce an alarm or not. If it does not produce an alarm but the LED is blinking, it means that the noise detector can still detect but the noise does not reach the sound level set on the noise detector. On the remarks, messages saved from the Z86733 microcontroller are transferred to the PIC16F877 for message display in the 8x8 LED Matrix. These messages are only displayed if the noise detector has enough voltage gain to trigger the microcontroller.

Sudden loud noise that occurred during testing such as sneezing, whistling, and banging of the door was easily detected.

Testing of Noise Detection with Varying Distances

The following materials were used to conduct the test: sound level meter, push-pull rule, and the noise detector circuit.

The noise detector was set to approximately 50 db noise level and in a testing room that measured 31' x 23.5' x 18.95'. The setting was only at the minimum noise level of 50 db because according to the researches, 40 db is the

considerable noise level in a library environment. Since the device was placed on each table inside the library, the distance of the source of sound is 0.25m, 0.5m, and 1m measured by the push-pull rule from the noise detector. This testing aimed to prove that the noise detector can detect different sound sources even if the source was almost one meter away from the noise detector. The sound level meter was used to measure the amount of noise in terms of decibel.

Source	Distance	Sound Level Meter	Remarks
Normal Conversation			
Trial 1	0.25 m	55dB	Noise detected with message display
Trial 2	0.50 m	48 dB	Noise detected but with no message display
Trial 3	1 m	40 dB	Noise detected but with no message display
Music			
Trial 1	0.25 m	55 dB	Noise detected with message display
Trial 2	0.50	45 dB	Noise detected but with no message display
Trial 3	1 m	40 dB	Noise detected but with no message display
Scream			
Trial 1	0.25 m	58 dB	Noise detected with message display
Trial 2	0.50 m	51 dB	Noise detected with message display
Trial 3	1 m	45 dB	Noise detected but with no message display

Table 4.4 Testing Operation with Sound Level Meter

Based on the results in Table 4.4 the measured values have discrepancy due to the consistency of the sound sources that the sound level meter detects. The noise level of the sound varies with its distance to the sound level meter. When the source is near the sound level meter, the decibel value is higher and as it gets farther, the decibel value decreases. For this reason, the detection of

the noise detector also depends on the distance of the sound source. As the sound level meter measures the noise level, the noise detector also detects the noise at the same time. It shows that the noise level set in the potentiometer is only approximately 50 db since lower than 50 db is still detected by the noise detector. The remarks prove the design project set the validity of the input noise. It only triggers the PIC16F877 to send alert messages to be displayed in the 8x8 LED Matrix if it reaches the set noise level of 50 db. Even though detection of noise is in the process in the noise detector, the warning is only made if the source of noise will reach or exceed 50 db which proves the efficiency and quality of the noise detector and the microcontrollers for the message display as the design projects works altogether.

Chapter 5

CONCLUSION AND RECOMMENDATION

Conclusion

The design project was able to detect excessive noise and provide a short message to remind the library users not to make excessive noise. This feature of the design is an aid to avoid having too much noise created by the people inside the library.

The library staff takes care of borrowed and returned books as well as maintaining order in the library. The device will inform the library users through the detector's alarm and alert messages displayed on a LED matrix panel after detection of excessive noise; thus lessening the library staff's task of maintaining a quiet ambience.

Based on the research conducted, a noise detector was designed that can vary the noise level, and through microcontrollers, a message display device was used to add functions to the whole design system. The Library Noise Detector with Message Provider was put into operation by interfacing a noise detector's circuit into a microcontroller based 8x8 LED Matrix.

Most of the time, students go to the library just to hangout, chat with friends or use for their benefit of the facilities without realizing the disturbances they create. This design project will be very much effective in maintaining order in school libraries because it will make the students become aware of the proper manner inside the library.

Recommendation

A further enhancement on the design of the Library Noise Detector with Short Message Provider is recommended in terms of its capacity for detection of other kinds of noise sources and its message provider. Making the design not just portable but also wireless would be a great improvement of the design itself. A Wireless FM Transmitter and Receiver can be used in order to transmit the input signals from the microphone to the system design. This device is also used to create a wireless connection from the noise detector to the message display device. This is implemented to provide convenience and allows the library staff or roaming security guard to control the device at a distance of 10 meters maximum. For practicality means it is much better to have only one set of the Library Noise Detector provided that it can detect noise in a larger area and alert messages are displayed in larger panel of LED Matrix.

The design system can also be applied in classrooms, offices and in any environment where silence needs to be observed. More improvement can be applied in the packaging of the whole system design, to have a more sophisticated look in putting altogether all the parts or input/output devices of the design prototype.

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APPENDIX A

Material Listings and Price Lists

List of Materials

MATERIALS	QUANTITY	PRICE	TOTAL
Z86733 Microcontroller IC	1 pc	P200.75	P200.75
10.240Mhz crystal	1 pc	P35.00	P35.00
27 pf np capacitor	2 pcs	P2.50	P5.00
78L05	1 pc	P18.00	P18.00
Male-female connector	1 pc	P25.00	P25.00
0.1 uf capacitor	1 pc	P2.50	P2.50
Keypad	1 pc	P113.00	P113.00
2x40 LCD	1 pc	P700.00	P700.00
1k resistor	3 pc	P1.00	P3.00
10k resistor	6 pcs	P1.00	P4.00
56k resistor	3 pcs	P1.00	P3.00
33k resistor	1 pc	P1.00	P1.00
22k resistor	2 pcs	P1.00	P2.00
Lm7805/Lm7808	2 pc	P24.00	P48.00
750 mA transformer	1 pc	P187.00	P187.00
2200 uf/25v	1 pc	P8.00	P8.00

Toggle switch	2 pcs	P10.00	P20.00
Tact switch	1 pc	P 18.00	P 18.00
14”x18” Plywood	2 pcs	P75.00	P150.00
PCB	1 pc	P160.00	P160.00
1N4001	2 pcs	P2.00	P4.00
PIC16f877	1 pc	P225.00	P225.00
03SBA10 bridge rectifier diode	1 pc	P35.00	P35.00
0.1 uf capacitor	4 pcs	P2.50	P10.00
2n3904	8 pcs	P5.00	P40.00
2200 uf/35v capacitor	1 pc	P12.00	P12.00
Wireless doorbell	1 pc	P499.95	P499.95
Electret Microphone	1 pc	P 150.00	P150.00
Total			P 4,952.20

APPENDIX B

Data sheets

MICROCHIP

PIC16F87X

28/40-Pin 8-Bit CMOS FLASH Microcontrollers

Devices Included in this Data Sheet:

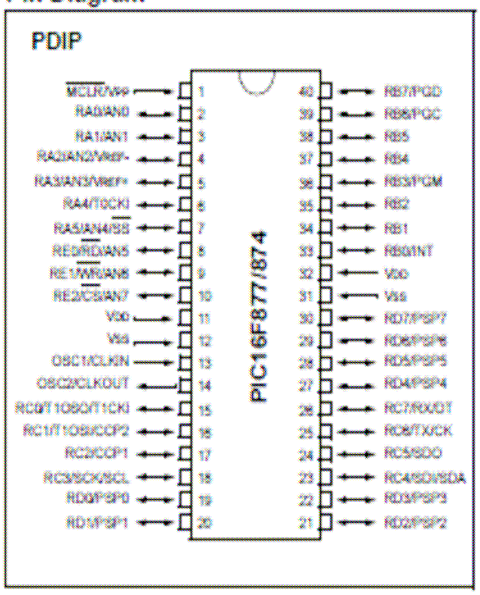
- PIC16F873
- PIC16F874
- PIC16F876
- PIC16F877

Microcontroller Core Features:

- High performance RISC CPU
- Only 35 single word instructions to learn
- All single cycle instructions except for program branches which are two cycle
- Operating speed: DC - 20 MHz clock input
  DC - 200 ns instruction cycle
- Up to 8K x 14 words of FLASH Program Memory,
  Up to 368 x 8 bytes of Data Memory (RAM)
  Up to 256 x 8 bytes of EEPROM Data Memory
- Pinout compatible to the PIC16C73B/74B/76/77
- Interrupt capability (up to 14 sources)
- Eight level deep hardware stack
- Direct, indirect and relative addressing modes
- Power-on Reset (POR)
- Power-up Timer (PWRT) and
  Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving SLEEP mode
- Selectable oscillator options
- Low power, high speed CMOS FLASH/EEPROM technology
- Fully static design
- In-Circuit Serial Programming™ (ICSP) via two pins
- Single 5V In-Circuit Serial Programming capability
- In-Circuit Debugging via two pins
- Processor read/write access to program memory
- Wide operating voltage range: 2.0V to 5.5V
- High Sink/Source Current: 25 mA
- Commercial, Industrial and Extended temperature ranges
- Low-power consumption:
  - < 0.6 mA typical @ 3V, 4 MHz
  - 20 µA typical @ 3V, 32 kHz
  - < 1 µA typical standby current

Pin Diagram

PDIP



Peripheral Features:

- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler, can be incremented during SLEEP via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two Capture, Compare, PWM modules
  - Capture is 16-bit, max. resolution is 12.5 ns
  - Compare is 16-bit, max. resolution is 200 ns
  - PWM max. resolution is 10-bit
- 10-bit multi-channel Analog-to-Digital converter
- Synchronous Serial Port (SSP) with SPI™ (Master mode) and I²C™ (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) 8-bits wide, with external $\overline{RD}$, $\overline{WR}$ and $\overline{CS}$ controls (40/44-pin only)
- Brown-out detection circuitry for Brown-out Reset (BOR)

PIN IDENTIFICATION

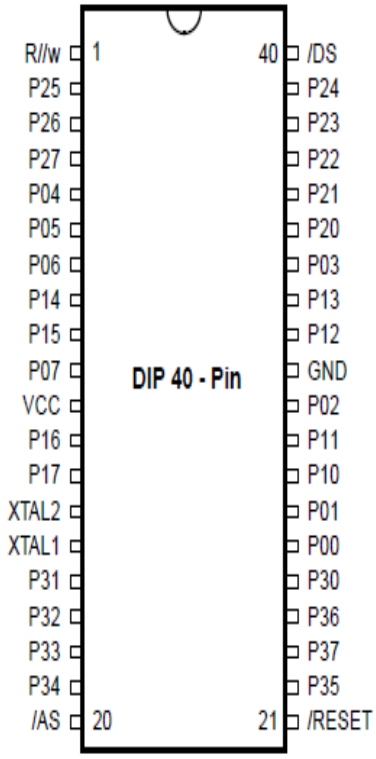


Figure 3. 40-Pin DIP Pin Configuration Standard Mode

Table 1. 40-Pin DIP Pin Identification Standard Mode

Pin #	Symbol	Function	Direction
1	R/W	Read/Write	Output
2-4	P25-P27	Port 2, Pins 5,6,7	In/Output
5-7	P04-P06	Port 0, Pins 4,5,6	In/Output
8-9	P14-P15	Port 1, Pins 4,5	In/Output
10	P07	Port 0, Pin 7	In/Output
11	V_{CC}	Power Supply	
12-13	P16-P17	Port 1, Pins 6,7	In/Output
14	XTAL2	Crystal Oscillator	Output
15	XTAL1	Crystal Oscillator	Input
16-18	P31-P33	Port 3, Pins 1,2,3	Input
19	P34	Port 3, Pin 4	Output
20	/AS	Address Strobe	Output
21	/RESET	Reset	Input
22	P35	Port 3, Pin 5	Output
23	P37	Port 3, Pin 7	Output
24	P36	Port 3, Pin 6	Output
25	P30	Port 3, Pin 0	Input
26-27	P00-P01	Port 0, Pins 0,1	In/Output
28-29	P10-P11	Port 1, Pins 0,1	In/Output
30	P02	Port 0, Pin 2	In/Output
31	GND	Ground	
32-33	P12-P13	Port 1, Pins 2,3	In/Output
34	P03	Port 0, Pin 3	In/Output
35-39	P20-P24	Port 2, Pins 0,1,2,3,4	In/Output
40	/DS	Data Strobe	Output

Dual Operation Amplifiers

LM358

General Description

The LM358 consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, dc gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. For example, the LM358 can be directly operated off of the standard +5V power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional ±15V power supplies.

Unique Characteristics

- In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage.
- The unity gain cross frequency is temperature compensated.
- The input bias current is also temperature compensated.

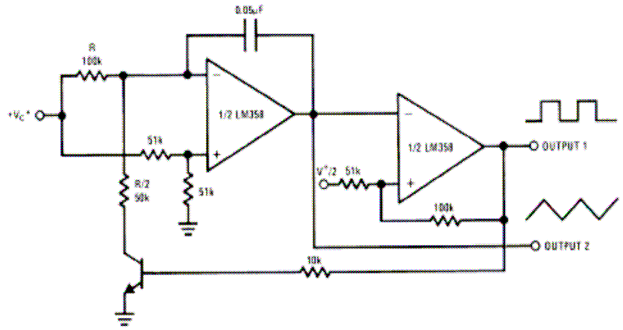
Advantages

- Two internally compensated op amps
- Eliminates need for dual supplies
- Allows direct sensing near GND and V_{OUT} also goes to GND
- Compatible with all forms of logic
- Power drain suitable for battery operation
- Pin-out same as LM1558/LM1458 dual op amp

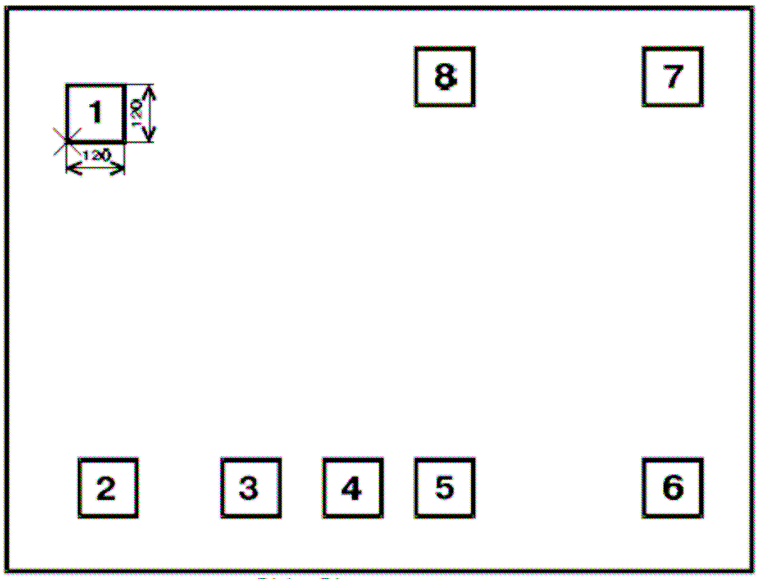
Features

- Internally frequency compensated for unity gain
- Large dc voltage gain: 100 dB
- Wide bandwidth (unity gain): 1 MHz (temperature compensated)
- Wide power supply range:
  — Single supply: 3V to 32V
  — or dual supplies: ±1.5V to ±16V
- Very low supply current drain (500 μA)—essentially independent of supply voltage
- Low input offset voltage: 2 mV
- Input common-mode voltage range includes ground
- Differential input voltage range equal to the power supply voltage
- Large output voltage swing: 0V to V^+− 1.5V

Voltage Controlled Oscillator (VCO)



Pad Location



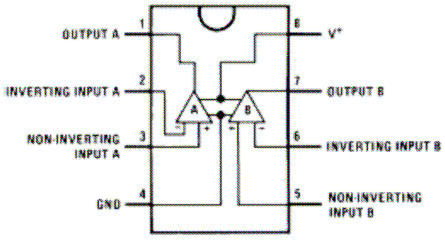
Chip Size: 1.65 x 0.9 mm

Pad N	Pad Name	Coordinates, mkm	
		X	Y
1	#1 OUT	85	625
2	#1 IN-	182	88
3	#1 IN+	518	88
4	GND	845	88
5	#2 IN+	1045	88
6	#2 IN-	1381	88
7	#2 OUT	1478	625
8	V_{CC}	909	720

Connection Diagrams

LM358N

DIP-8



APPENDIX C

Program Listing

Program Listing in the Z86733 for Keypad and LCD

```
data_set1       .equ 20h      ;lcd
data_set2       .equ 21h
data_out        .equ 22h
position        .equ 23h
milli           .equ 24h      ;3sec delay
press_no        .equ 25h      ;keypad
counter         .equ 26h
letra           .equ 27h
variable1       .equ 28h
variable2       .equ r10
value           .equ r11
ctr             .equ r12
bitrate         .equ r13
com_flag        .equ r14
shift_bit       .equ r15
seconds         .equ 6ch
indicator       .equ 6dh


                .org 00h
                .word 0ffffh  ;p33
                .word 0ffffh  ;p32
                .word 0ffffh  ;p31
                .word 0ffffh  ;p30
                .word baudrate
                .word timer_int
                .org 0ch

di              ;disable interrupt
srp #10h        ;set register pointer to #10h
ld spl,#80h     ;initialized stack pointer at 80h
ld p01m,#04h    ;set port0( p0 )as output
ld p2m,#00110000b ;set port2 (p2 )as output
ld p3m,#01h     ;set port2 as digit and push-pull mode

clr irq
clr ipr
ld t1,#3bh
ld pre1,#00010011b
ld pre0,#00100101b ;104 micro secs.
ld t0,#15       ;note set crystal oscillator 11.150mhz; 15 use 10.24mhz
ld imr,#30h
ei              ;enable interrupt
```

```
call erase_ram
ld r4,#29h
ld 28h,#0ffh
clr p3
clr p0
call delay2
call lcd_init

restart:
        ld r6,#>tittle
        ld r7,#<tittle
        call line1
        ld r6,#>school
        ld r7,#<school
        call line2
        call delay2
        call line2
        ld position,#0c3h       ; starting position of char display in the lcd
        ld r6,#>clear
        ld r7,#<clear
        call line1
        ld r6,#>clear
        ld r7,#<clear
        call line2
        jr input

loop_restart:
        tm p3,#01h
        jr z,loop_restart
        ld r6,#>clear
        ld r7,#<clear
         call line2
         call delay

input:
        ld r6,#>lower
        ld r7,#<lower
        call line1
        call delay
        call keypad
input_a:
        cp press_no,#02h
        jp eq,keyabc
        cp press_no,#03h
        jp eq,keydef
        cp press_no,#04h
```

```
                jp eq,keyghi
                cp press_no,#05h
                jp eq,keyjkl
                cp press_no,#06h
                jp eq,keymno
                cp press_no,#07h
                jp eq,keyprs
                cp press_no,#08h
                jp eq,keytuv
                cp press_no,#09h
                jp eq,keywxy
                cp press_no,#00h
                jp eq,keyzero
                cp press_no,#0f3h
                jr eq,upper_input
                jr input

upper_input:
                ld r6,#>upper
                ld r7,#<upper
                call line1
                call delay
                call keypad
upper_a:
                cp press_no,#02h
                jp eq,keyABC
                cp press_no,#03h
                jp eq,keyDEF
                cp press_no,#04h
                jp eq,keyGHI
                cp press_no,#05h
                jp eq,keyJKL
                cp press_no,#06h
                jp eq,keyMNO
                cp press_no,#07h
                jp eq,keyPRS
                cp press_no,#08h
                jp eq,keyTUV
                cp press_no,#09h
                jp eq,keyWXY
                cp press_no,#00h
                jp eq,keyZERO
                cp press_no,#0f3h
                jp eq,numlock
                jr upper_input
```

```
numlock:
        ld r6,#>number
        ld r7,#<number
        call line1
        call delay
        or tmr,#0ch
numlock_a:
        call keypad
        cp press_no,#01h
        jr eq,key1
        cp press_no,#02h
        jp eq,key2
        cp press_no,#03h
        jp eq,key3
        cp press_no,#04h
        jp eq,key4
        cp press_no,#05h
        jp eq,key5
        cp press_no,#06h
        jp eq,key6
        cp press_no,#07h
        jp eq,key7
        cp press_no,#08h
        jp eq,key8
        cp press_no,#09h
        jp eq,key9
        cp press_no,#00h
        jp eq,key0
        cp press_no,#0f3h
        jp eq,input
        jr numlock_a


readytosend:
        ld r1,#29h
        ld r0,#'A'
        call tx_data
        ld r0,#'T'
        call tx_data
        ld r0,#'+'
        call tx_data
send_msg:
        ld r0,@r1       ;transfer the content data of address to working reg r0
        call tx_data    ;pulse enable
        inc r1
        cp r1,#6ah
```

```
                jr eq,return1    ;inc address to fetch next character from ascii
                jr send_msg
return1:
                ld r0,#0h
                call tx_data
                ld p0,#06h       ; this is for the alarm on state
                call delay2
                ld p0,#0h        ; alarm off state
hang:

                tm p2,#20h
                jr nz,readytosendb
                jr hang
readytosendb:
                tm p2,#20h
                jr nz,readytosendb
                jr readytosend

;========= numlock text =========

key1:
                ld letra,#02h
                ld variable1,#'1'
                ld variable2,#02h
                call showtxt
                jp numlock_a
key2:
                ld letra,#02h
                ld variable1,#'2'
                ld variable2,#02h
                call showtxt
                jp numlock_a
key3:
                ld letra,#02h
                ld variable1,#'3'
                ld variable2,#02h
                call showtxt
                jp numlock_a
key4:
                ld letra,#02h
                ld variable1,#'4'
                ld variable2,#02h
                call showtxt
                jp numlock_a
key5:
                ld letra,#02h
```

```
                ld variable1,#'5'
                ld variable2,#02h
                call showtxt
                jp numlock_a
key6:
                ld letra,#02h
                ld variable1,#'6'
                ld variable2,#02h
                call showtxt
                jp numlock_a
key7:
                ld letra,#02h
                ld variable1,#'7'
                ld variable2,#02h
                call showtxt
                jp numlock_a
key8:
                ld letra,#02h
                ld variable1,#'8'
                ld variable2,#02h
                call showtxt
                jp numlock_a
key9:
                ld letra,#02h
                ld variable1,#'9'
                ld variable2,#02h
                call showtxt
                jp numlock_a
key0:
                ld letra,#02h
                ld variable1,#'0'
                ld variable2,#02h
                call showtxt
                jp numlock_a

;========== keytext ==========

keyabc:
                ld letra,#04h
                ld variable1,#'a'
                ld variable2,#02h
                call showtxt
                jp input_a
keydef:
                ld letra,#04h
                ld variable1,#'d'
```

```
                ld variable2,#03h
                call showtxt
                jp input_a
keyghi:
                ld letra,#04h
                ld variable1,#'g'
                ld variable2,#04h
                call showtxt
                jp input_a
keyjkl:
                ld letra,#04h
                ld variable1,#'j'
                ld variable2,#05h
                call showtxt
                jp input_a
keymno:
                ld letra,#04h
                ld variable1,#'m'
                ld variable2,#06h
                call showtxt
                jp input_a
keyprs:
                ld letra,#05h
                ld variable1,#'p'
                ld variable2,#07h
                call showtxt
                jp input_a
keytuv:
                ld letra,#04h
                ld variable1,#'t'
                ld variable2,#08h
                call showtxt
                jp input_a
keywxy:
                ld letra,#05h
                ld variable1,#'w'
                ld variable2,#09h
                call showtxt
                jp input_a
keyzero:
                ld letra,#02h
                ld variable1,#20h
                ld variable2,#00h
                call showtxt
                jp input_a
keyautospace:
```

```
                ld letra,#02h
                ld variable1,#20h
                ld variable2,#0ffh
                call showtxt
                jp input_a

keyABC:
                ld letra,#04h
                ld variable1,#'A'
                ld variable2,#02h
                call showtxt
                jp upper_a
keyDEF:
                ld letra,#04h
                ld variable1,#'D'
                ld variable2,#03h
                call showtxt
                jp upper_a
keyGHI:
                ld letra,#04h
                ld variable1,#'G'
                ld variable2,#04h
                call showtxt
                jp upper_a
keyJKL:
                ld letra,#04h
                ld variable1,#'J'
                ld variable2,#05h
                call showtxt
                jp upper_a
keyMNO:
                ld letra,#04h
                ld variable1,#'M'
                ld variable2,#06h
                call showtxt
                jp upper_a
keyPRS:
                ld letra,#05h
                ld variable1,#'P'
                ld variable2,#07h
                call showtxt
                jp upper_a
keyTUV:
                ld letra,#04h
                ld variable1,#'T'
                ld variable2,#08h
```

```
                call showtxt
                jp upper_a
keyWXY:
                ld letra,#05h
                ld variable1,#'W'
                ld variable2,#09h
                call showtxt
                jp upper_a
keyZERO:
                ld letra,#02h
                ld variable1,#20h
                ld variable2,#00h
                call showtxt
                jp upper_a
keyAUTOSPACE:
                ld letra,#02h
                ld variable1,#20h
                ld variable2,#0ffh
                call showtxt
                jp upper_a

;======== keypad routine========
keypad:
                clr seconds
keypad_a:
                jp delete_button
loop_keypad:
                cp seconds,#18          ; timer for auto increment
                jp uge,keypad_out
                and p0,#00000000b
                or p0,#01110000b
                tm p3,#02h
                jr nz,two
                call delayk
                ld press_no,#01h
                ret
two:
                tm p3,#04h
                jr nz,three
                call delayk
                ld press_no,#02h
                ret
three:
                tm p3,#08h
                jr nz,four
                call delayk
```

```
                ld press_no,#03h
                ret
four:
                call wait_1
                and p0,#00000000b
                or p0,#10110000b
                tm p3,#02h
                jr nz,five
                call delayk
                ld press_no,#04h
                ret
five:
                tm p3,#04h
                jr nz,six
                call delayk
                ld press_no,#05h
                ret
six:
                tm p3,#08h
                jr nz,seven
                call delayk
                ld press_no,#06h
                ret
seven:
                call wait_1
                and p0,#00000000b
                or p0,#11010000b
                tm p3,#02h
                jr nz,eight
                call delayk
                ld press_no,#07h
                ret
eight:
                tm p3,#04h
                jr nz,nine
                call delayk
                ld press_no,#08h
                ret
nine:
                tm p3,#08h
                jr nz,ask
                call delayk
                ld press_no,#09h
                ret
ask:
                call wait_1
```

```
                and p0,#00000000b
                or p0,#11100000b
                tm p3,#02h
                jr nz,zero
                call delayk
                ld press_no,#'*'
                sub press_no,#30h
                ret
zero:
                tm p3,#04h
                jr nz,sharp
                call delayk
                ld press_no,#0h
                ret
sharp:
                tm p3,#08h
                jp nz,keypad_a
                call delayk
                ld press_no,#'#'
                sub press_no,#30h
                ret
keypad_out:
                ld press_no,#0ffh
                ret
delete_button:
                tm p2,#10h
                jr z,erase_char
                tm p2,#20h
                jp nz,readytosend
                tm p3,#01h
                jp z,message_one
                jp loop_keypad
erase_char:
                clr seconds
looperase_char:
                cp seconds,#20
                jr ule,looperase_char
                cp position,#0c3h
                jr eq,exit_erase
                dec position
                dec r4
loop_erase:
                cp seconds,#30          ; timer for erasing all char
                jr uge,erase_lahat
                tm p2,#10h
                jr z,loop_erase
```

```
                ld data_out,#20h
                call dis_char
                ld press_no,#0edh       ; flag for erasing a char
                ret
exit_erase:
                ld position,#0c3h
                ret
erase_lahat:
                ld r0,#00
                ld r1,#29h
clean:
                ld @r1,r0
                inc r1
                cp r1,#069h
                jr ne,clean
                ld position,#0c3h
                ld r4,#29h
                ld r6,#>clear
                ld r7,#<clear
                call line2
                ret

;================================
showtxt:
                or tmr,#0ch
                clr counter
                ld value,variable1
showtxt1:
                call lcddisplay
                inc counter
                cp counter,letra
                jr uge,showtxt
                call keypad
                cp press_no,#0edh
                jr eq,exittext
                cp press_no,#0d0h
                jr eq,exittext
                cp press_no,variable2
                jr ne,outshowtx
                inc value
                clr seconds
                jr showtxt1
outshowtx:
                cp position,#0e5h
                jr eq,stoptxt
                cp press_no,#0ffh
```

```
                jr eq,autospace
                cp indicator,#0ffh  ; autospace flag
                jr eq,stoptxt
                inc position
                inc r4
exittext:
                ret
stoptxt:
                clr indicator
                ret
autospace:
                inc position
                inc r4
                ld indicator,#0ffh  ; the autospace happens
                ret
lcddisplay:
                ld @r4,value
                ld data_out,value
                call dis_char
                ret

;========== transmit routine=========
tx_data:
                rcf
                or p0,#01h
                clr ctr
                clr bitrate
                and com_flag,#11111110b     ;clr rx_flag
                or tmr,#03h
idle:           or p0,#01h                  ;idle
                cp bitrate,#1
                jr ne,idle
                rl r0
                rl r0
start_bit:
                and p0,#0feh                ;start bit
                cp bitrate,#2
                jr ne,start_bit
                or p0,shift_bit             ;8 bit data shift
                clr ctr
                rcf
                ld shift_bit,r0
                and shift_bit,#01h
loop_upto8:
                or p0,shift_bit             ; data shift
                cp ctr,#8
```

```
                jr ult,loop_upto8
                and tmr,#0fch
                or p0,#01h
                ret
baudrate:
                rr r0
                ld shift_bit,r0
                and shift_bit,#01h
                and p0,#0feh
                inc ctr
                inc bitrate
                iret

;========== LCD routine============

display:
                add data_out,#30h
dis_char:
                ld data_set1,position
                call pulse
                ld r8,data_out
                call pulse1
                ret
display_back:
                add data_out,#30h
dis_char1:
                ld data_set1,position
                call pulse
                ld r8,data_out
                call pulse1
                dec position
                ret

line1:
                ld data_set1,#80h       ;set first address of first line
                call pulse              ;pulse register select
                call display_msg        ;go to fetching of data from ascii setting
                ret                     ;return
line2:
                ld data_set1,#0c0h
                call pulse
                call display_msg
                ret
display_msg:
                ldc r8,@RR6   ;transfer the content data of address to working reg r8
                cp r8,#24h
```

```
                jp eq,return
                call pulse1     ;pulse enable
                incw RR6        ;inc address to fetch next character from ascii
                djnz r9,display_msg   ;dec working reg. r9 and check if 0, end of line
return:
                ld r9,#40       ;reset the character counter
                clr r8
                ret
lcd_init:
                ld data_set1,#02h     ;set data length for 8 bits/5x7 dots/2line
                call pulse            ;pulse enable pin
                ld data_set1,#28h
                call pulse
                ld data_set1,#28h
                call pulse
                ld data_set1,#28h     ;entry mode:inc address ,no shift
                call pulse            ;pulse enable pin
                ld data_set1,#0ch     ;set dd ram
                call pulse            ;pulse enable pin
                ld data_set1,#06h     ;set dd ram
                call pulse            ;pulse enable pin
                ld data_set1,#01h     ;set dd ram
                call pulse            ;pulse enable pin
                ld data_set1,#02h     ;set dd ram
                call pulse            ;pulse enable pin
                ld data_set1,#40h     ;set dd ram
                call pulse            ;pulse enable pin
                ld data_set1,#80h     ;set dd ram
                call pulse            ;pulse enable pin
                call delay
                ld r9,#40
                ret                   ;return end of initialization
pulse:
                call split_data
                and p2,#0f0h
                or p2,data_set1
                or p2,#80h            ;#20h;set enable pin to high state
                and p2,#7fh           ;#0dfh ;set it low
                and p2,#0f0h
                or p2,data_set2
                or p2,#80h            ;#20h;set enable pin to high state
                and p2,#7fh           ;#0dfh
                and p2,#0f0h
                call wait_1           ;wait awhile
                ret                   ;return
pulse1:
```

```
                ld data_set1,r8
                call split_data
                and p2,#0f0h
                or p2,data_set1     ;load data to port 2
                and p2,#03fh        ;#0cfh
                or p2,#40h          ;#10h;set register select high
                nop
                nop
                nop
                or p2,#80h          ;#20h;set enable and register select pin high
                and p2,#07fh        ;#0dfh
                call wait_1
                and p2,#0f0h
                or p2,data_set2     ;load data to port 2
                and p2,#03fh        ;#0cfh
                or p2,#40h          ;#10h;set register select high
                nop
                nop
                nop
                or p2,#80h          ;#20h;set enable and register select pin high
                and p2,#07fh        ;#0dfh
                nop
                nop
                nop
                and p2,#03fh        ;#0cfh
                call wait_1         ;clear both pin
                ret
split_data:
                ld data_set2,data_set1
                swap data_set1
                and data_set1,#0fh
                and data_set2,#0fh
                ret
erase_ram:
                ld r0,#00
                ld r1,#12h
clean2:
                ld @r1,r0
                inc r1
                cp r1,#07fh
                jr ne,clean2
                ld r1,#31h
                ret

;========== timer interrupt routine ===========
timer_int:
```

```
                inc milli
                cp milli,#100
                jr uge,segundo
                iret
segundo:
                clr milli
                inc seconds
                iret

;======== delay routine =========
wait_1:
                ld r3,#1fh
busy:
                djnz r3,busy
                ret
delay:
                ld r3,#01fh
loop1:
                ld r2,#0ffh
loop2:
                djnz r2,loop2
                djnz r3,loop1
                ret
delay2:
                ld      r0,#100
del:
                call delay
                dec r0
                cp r0,#0
                jr ne,del
                ret
delayk:
                ld r6,p3
                rr r6
                and r6,#07h
                cp r6,#07h
                jr ne,delayk
                clr p3
                call delay
                ret

;========== default display for matrix =============
message_one:
                tm p3,#01h
                jr z,message_one
                call erase_lahat
```

```
;observe_silence:
                ld r6,#>message1
                ld r7,#<message1
                call line1
                ld r6,#>observe
                ld r7,#<observe
                call line2
                ld 29h,#'O'
                ld 2ah,#'b'
                ld 2bh,#'s'
                ld 2ch,#'e'
                ld 2dh,#'r'
                ld 2eh,#'v'
                ld 2fh,#'e'
                ld 30h,#' '
                ld 31h,#'s'
                ld 32h,#'i'
                ld 33h,#'l'
                ld 34h,#'e'
                ld 35h,#'n'
                ld 36h,#'c'
                ld 37h,#'e'
loop_msg1:
                tm p2,#20h
                jr nz,readytosendmsg1
                tm p3,#01h
                jr z,message_two
                jr loop_msg1
readytosendmsg1:
                tm p2,#20h
                jr nz,readytosendmsg1
                call send_savemessage
                jr loop_msg1

message_two:
                tm p3,#01h
                jr z,message_two
                call erase_lahat
                ld r6,#>message2
                ld r7,#<message2
                call line1
                ld r6,#>do_not
                ld r7,#<do_not
                call line2
                ld 29h,#' '
                ld 2ah,#'D'
```

```
                ld 2bh,#'o'
                ld 2ch,#' '
                ld 2dh,#'n'
                ld 2eh,#'o'
                ld 2fh,#'t'
                ld 30h,#' '
                ld 31h,#'l'
                ld 32h,#'e'
                ld 33h,#'a'
                ld 34h,#'v'
                ld 35h,#'e'
                ld 36h,#' '
                ld 37h,#'t'
                ld 38h,#'h'
                ld 39h,#'i'
                ld 3ah,#'n'
                ld 3bh,#'g'
                ld 3ch,#'s'
                ld 3dh,#' '
                ld 3eh,#'u'
                ld 3fh,#'n'
                ld 40h,#'a'
                ld 41h,#'t'
                ld 42h,#'t'
                ld 43h,#'e'
                ld 44h,#'n'
                ld 45h,#'d'
                ld 46h,#'e'
                ld 47h,#'d'
loop_msg2:
                tm p2,#20h
                jr nz,readytosendmsg2
                tm p3,#01h
                jr z,message_three
                jr loop_msg2
readytosendmsg2:
                tm p2,#20h
                jr nz,readytosendmsg2
                call send_savemessage
                jr loop_msg2

message_three:
                tm p3,#01h
                jr z,message_three
                call erase_lahat
                ld r6,#>message3
```

```
                ld r7,#<message3
                call line1
                ld r6,#>sleeping
                ld r7,#<sleeping
                call line2
;sleeping:
                ld 29h,#' '
                ld 2ah,#'s'
                ld 2bh,#'l'
                ld 2ch,#'e'
                ld 2dh,#'e'
                ld 2eh,#'p'
                ld 2fh,#'i'
                ld 30h,#'n'
                ld 31h,#'g'
                ld 32h,#' '
                ld 33h,#'a'
                ld 34h,#'n'
                ld 35h,#'d'
                ld 36h,#' '
                ld 37h,#'e'
                ld 38h,#'a'
                ld 39h,#'t'
                ld 3ah,#'i'
                ld 3bh,#'n'
                ld 3ch,#'g'
                ld 3dh,#' '
                ld 3eh,#'a'
                ld 3fh,#'r'
                ld 40h,#'e'
                ld 41h,#' '
                ld 42h,#'n'
                ld 43h,#'o'
                ld 44h,#'t'
                ld 45h,#' '
                ld 46h,#'a'
                ld 47h,#'l'
                ld 46h,#'l'
                ld 47h,#'o'
                ld 46h,#'w'
                ld 47h,#'e'
                ld 46h,#'d'
loop_msg3:
                tm p2,#20h
                jr nz,readytosendmsg3
                tm p3,#01h
```

```
                jp z,loop_restart
                jr loop_msg3
readytosendmsg3:
                tm p2,#20h
                jr nz,readytosendmsg3
                call send_savemessage
                jr loop_msg3

message_four:
                tm p3,#01h
                jr z,message_three
                call erase_lahat
                ld r6,#>message4
                ld r7,#<message4
                call line1
                ld r6,#>cellphone
                ld r7,#<cellphone
                call line2
;cellphone:
                ld 29h,#' '
                ld 2ah,#'c'
                ld 2bh,#'e'
                ld 2ch,#'l'
                ld 2dh,#'l'
                ld 2eh,#'p'
                ld 2fh,#'h'
                ld 30h,#'o'
                ld 31h,#'n'
                ld 32h,#'e'
                ld 33h,#' '
                ld 34h,#'a'
                ld 35h,#'r'
                ld 36h,#'e'
                ld 37h,#' '
                ld 38h,#'n'
                ld 39h,#'o'
                ld 3ah,#'t'
                ld 3bh,#' '
                ld 3ch,#'a'
                ld 3dh,#'l'
                ld 3eh,#'l'
                ld 3fh,#'o'
                ld 40h,#'w'
                ld 41h,#'e'
                ld 42h,#'d'
```

```
loop_msg4:
        tm p2,#20h
        jr nz,readytosendmsg4
        tm p3,#01h
        jp z,loop_restart
        call erase_lahat
        jr loop_msg4
readytosendmsg4:
        tm p2,#20h
        jr nz,readytosendmsg4
        call send_savemessage
        jr loop_msg4

send_savemessage:
        ld r1,#29h
        ld r0,#'A'
        call tx_data
        ld r0,#'T'
        call tx_data
        ld r0,#'+'
        call tx_data
loopsend_msg:
        ld r0,@r1       ;transfer the content data of address to working reg r0
        call tx_data    ;pulse enable
        inc r1
        cp r1,#6ah
        jr eq,return1a  ;inc address to fetch next character from ascii
        jr loopsend_msg
return1a:
        ld r0,#0h
        call tx_data
        ld p0,#06h      ; this is for the alarm on state
        call delay2
        ld p0,#0h       ; alarm off state
        ret

;======== LCD display =========
clear:
        .ascii "                                $"
tittle:
        .ascii "  Microcontroller Based Matrix Display  $"
school:
        .ascii "     Mapua Institute of Technology      $"
lower:
        .ascii "-->lowercase:                       $"
upper:
```

```
                .ascii "-->uppercase:     $"
number:
                .ascii "-->num. lock:     $"
message1:
                .ascii "-->message one:   $"
message2:
                .ascii "-->message two:   $"
message3:
                .ascii "-->message three: $"
observe:
                .ascii "Observe Silence$"
do_not:
                .ascii "Do not leave your things unattended$"
sleeping:
                .ascii "Sleeping and eating are not allowed$"
cellphone:
                .ascii "Cellphones are not allowed$"
                .end
```

APPENDIX D

User's Manual

Library Noise Detector with Short Information Display

User's Manual

These are the proper ways in using the designed noise detector:

1. Initially plug on the device in a 220 VAC to turn-on the system design. Make sure that the toggle switch on the noise detector is turned-off before any task is be done.
8. To choose whether the message is a user input or a stored message, press the push button beside the keypad. A stored message appears when the button is pushed. If you want to display a personal input message to display, wait until a blank selection appears.
9. If it is a user input message, enter the short information that you want to display during the detection of the noise within the library. Enter alert messages that can really catch the attention of the library user.
10. The keypad functions like the cellular phone keypad and the tact switch beside the keypad is used for deleting a character.
11. Set the desired level of sensitivity of the sensor by turning the knob of the noise detector. The clockwise direction makes the noise detector turn from 50 decibel to 80 decibel.
12. Turn on the toggle switch in the noise detector to start the communication between the display device and the noise detector.

13. Leave the device on the table or in a specific place in the library then let it function by itself. A default message of "Mapua Library" will be shown until noise is detected. The chime sound will occur, the LED indicator in the sensor blinks, and the entered short information will be displayed once noise is sensed.

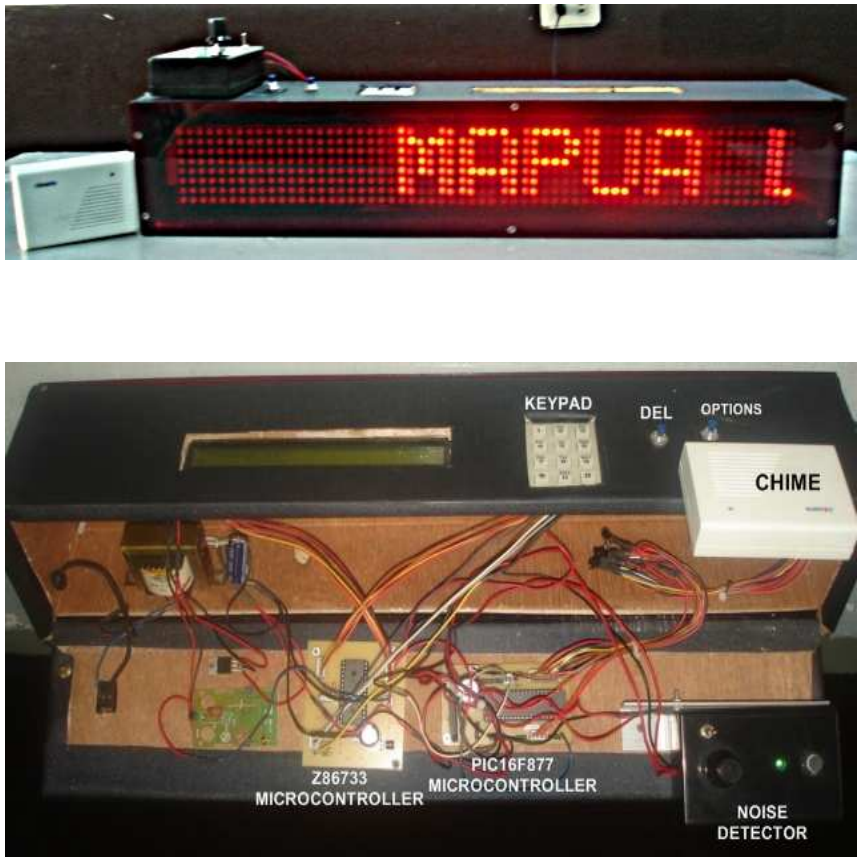


Figure 6. Pictures of the actual Library Noise Detector with Short Information Provider